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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

SEPTEMBER 12-15.
Iron and Steel Institute:—Autumn meeting at Sheffield.

Plastics.

We referred in a recent issue to some of the drawbacks in service of plastic materials, the effect of which on the metal industries has recently been giving rise to some speculation. These materials are resins made synthetically from organic materials, and were originally developed as electrical insulators, since the best insulators are found among non-metallic materials. They have been applied continuously in the electrical industry, and in certain directions their decorative effect and the ease with which they can be moulded has enabled them to displace certain pressed metal parts; for instance, switch covers. Quite recently the chairman of the plastics group of the Society of Chemical Industry gave some interesting possibilities for the future, and indeed prophesied the end of the metal age. He visualised the time when, for example, automobile bodies will be pressed out of artificial resin and when ships will be made of the same material. He thought the time would come when they would be produced in strengths at least as good as those of the metals. It is estimated that the industry at the present time has a turnover of £20,000,000 annually in electrical fittings and domestic articles, such as toilet and table ware, etc. It cannot be said, however, that as yet any serious inroad has been made into the iron and steel industry, and indeed since these materials can only be made in metal dies they have created a new section of the iron and steel industry. We therefore doubt whether the future will see anything quite as revolutionary as is prophesied. New materials are repeatedly developing, but, speaking generally, they find their own particular level, and the new and the old continue to develop side by side.

Obviously the sheet-metal industry is the one which is most likely to be affected by developments in plastic materials, but it is rather difficult to assess what the effect is likely to be on cast metals. The rust-proof and insulating properties are likely to affect the non-ferrous metals most, as they have, indeed, hitherto done, but it would be unwise to disregard the possibility of the cast metals being affected, since plastic material is essentially cast in a metal mould. The drawbacks we mentioned will naturally receive the attention of the skilled chemists who have made a special study of these materials, and they are likely to provide more, rather than less, competition in future.

The Steel Industry and the Foundry.

THE FOUNDRY TRADE JOURNAL, ever since its inception in 1902, has had a close connection with the iron and steel industry. The connection of the foundry industry with the "iron" portion is obvious, as pig-iron constitutes one of its principal raw materials; but with "steel" the association is more obscure, yet distinctly interesting. At the present time it is apparent from the trade reports that the production of steel is on the up-grade. We can assume therefrom that the material being made is for shipbuilding, railways, constructional engineering, tubes and sheets. The major activity at the moment is for the lighter trades—automobile, tinplate and galvanised sheet. The first obvious reaction on the foundry industry is an increased demand for ingot moulds, furnace castings and rolls. With the imposition of the higher duty, the roll founders should feel an immediate benefit. Where increased tonnages of rails are being made, then there must be envisaged an increased consumption of chairs. Where ships plates are being produced in increased quantities, so also must there be a potential added activity in the foundries on the Clyde, Tyne and Tees. Structural steel when finally consumed involves the ordering up of gutters, fall-pipes, manhole covers, heating and ventilating installations, whilst even increased steel sheet usage indirectly causes a consumption of castings, not only in the manufacture and final fabrication, but also in finished assembles, such as motor-cars, toys and domestic appliances. The connection between the steel trade and foundry industry is so intimate that the statistics of the former can form a reliable guide as to the future trading conditions of the latter. Moreover it so happens that through the National Federation of Steel Manufacturers, the industry indicated is extremely well organised from the statistical aspect, and the iron-founding industry will never be satisfied until it is similarly served.

Book Review.

The Alloys of Iron and Molybdenum, by J. L. Gregg. Published for the Engineering Foundation by McGraw-Hill Publishing Company, Limited, Aldwych House, London, W.C.2. Price 36s. net.

In this age of alloy steels, it is not uncommon to hear the protagonists of one or other element, such as nickel, or chromium, refer to their particular fancy as being a "master alloy," without which certain developments in special steels would not have been made possible. While it would be idle to deny the immense value of, say nickel, chromium or tungsten, the widening knowledge of steel alloys makes the metallurgist less and less at the mercy of any particular alloying element. It is rather striking, however, that certain properties are conferred on steel alloys by the metal molybdenum that are not produceable by any other elements, so far as we know at the present time. Comparatively speaking, the use of molybdenum, as an alloying element in steel, is fairly modern, and apart from its use in tool steels it has found widest application, usually in combination with other elements, such as nickel, chromium and manganese, in high tensile steels for the manufacture of highly stressed parts of machinery. Its effect in the prevention of temper brittleness in such steels, and in reducing mass effect in heat-treatment, has been a real factor in the improvement of alloy steels for such purposes.

It is therefore with keen interest that we receive this book devoted entirely to alloys of iron and molybdenum. This is the first of a monograph series published for the Engineering Foundation under the direction of an influential Iron Alloys Committee, of which Dr. G. B. Waterhouse is Chairman and Director, and Mr. Frank T. Sisco is Editor.

Incidentally, the next volume dealing with alloys of iron and silicon, is expected to be published about September 1, and we are advised that the manuscript and several further monographs are nearing completion. The work by Mr. Gregg is essentially a critical review of published work. The abstracts are good and are well chosen, while the draftsmanship exhibited in various illustrations is excellent. An essential feature in a work of this kind is a complete bibliography, and this section, containing 515 references, leaves little to be desired.

The reviewer must regard a book of this type in a somewhat different light from that of an ordinary text book, but while, as before stated, the selection of work has been thoroughly done, and the references at least give reliable indication as to the work accomplished, the "Author's Summary," which appears at the end of each section, could, with advantage, be elaborated to some extent. We are afraid that the busy man who is tempted to rely essentially on the "Author's Summary" will miss a great deal of valuable information contained in the book. One realises the difficulty of assessing the value of the work of a large number of investigators, but it is felt that in many instances the "Author's Summary" is distinctly weak. This does not detract from the value of the book as a whole, but is given as a serious suggestion as to how future volumes might be improved.

As the volume consists essentially of quotations from the work of other investigators, it is clearly not necessary to comment in detail on this work as such, but the reviewer would suggest that the undoubted value of and the developing demand for the manganese molybdenum steels justifies rather stronger references to their value. The book is well indexed and deserves a place in the library of all concerns whose business it is to keep abreast with the development of manufacture of alloy steels. T. S.

District Presidents.—No. 4.

INSTITUTE OF BRITISH FOUNDRYMEN, NEWCASTLE BRANCH.

Mr. J. D. Carmichael, O.B.E., A.M.I.Mech.E., the President of the Newcastle Branch of the Institute of British Foundrymen, was born and educated in South Shields, where the family has carried on a foundry business for three generations. Having lived and been brought up in a foundry atmosphere, he persuaded his father to article him to a firm of architects, but after 18 months at a drawing board, he felt the urge and call of the foundry, forsook architecture and then became apprenticed to his father. When the war broke out he joined H.M. Forces as a despatch rider and was sent to France in 1914, and in 1915 was promoted in the field to Commissioned Rank in the Royal Engineers (Field Company). He was later transferred to Works Units, R.E., where his civil training was fully utilised. He built and equipped three separate foundry plants in various parts of France, and successfully manufactured hand and rifle grenades, spare parts of machinery, and dealt with the multifarious repairs to plant resultant from war-time conditions and wastage. For these services he was twice mentioned in

Mr. J. D. Carmichael.

despatches and awarded the Order of Officer of the British Empire.

At the close of hostilities he returned to the position of works manager with Messrs. Carmichael Bros., Limited, and later joined the board of directors, and is now general manager of the firm.

He is a life member of the Institute of British Foundrymen, which he joined in 1912 when the Newcastle and District Branch was first formed. He is an Associate Member of The Institution of Mechanical Engineers; one of the founders and instigators of the North-Eastern Branch and its first and present honorary secretary. He is representative member for the North-East Coast Engineering Employers' Association on the South Shields Employment Committee and member of the Court of Referees, and, also, a member of the Executive Board of the National Ironfounding Employers' Federation and the Committee of the North of England Ironfounders' Association.

It is interesting to recall that it is 15 years since Mr. Carmichael's father, the late Mr. J. D. Carmichael, occupied the position of President of the Newcastle and District Branch of the Institute of British Foundrymen.

Random Shots.

We are in favour, and always have been in favour, so the Editor tells me, of industrial welfare schemes. However, I have just read an improving article on industrial welfare by a spinsterish lady, whose connection with industry seems rather obscure, and I am beginning to have my doubts. After all, we must be practical. The lady's ideals of welfare in industry almost made me believe in a foundry which a friend of mine recently described to me (I thought he was pulling my leg. Was he?).

* * *

It is the custom of the managing director of this alleged foundry, my friend tells me, to call round every morning at the men's private residences, leaving flowers at some houses and cards of invitation to dinner at others. The idea is to establish friendly contact with the workpeople, and there certainly is amazing friendliness. The men are even so friendly as to "touch" the boss for a fiver here and a tenner there. The wives and children all call the managing director by his Christian name, and set playful boobytraps for him when he calls. The spirit of *camaraderie* is unbelievable. The men go to work any time in the morning, according to their own convenience. Some rules have to be made, however, and it is requested that they try to arrive by 11.30; otherwise their morning coffee gets cold.

* * *

Some difficulty was found in relieving the well-known monotony of many foundry duties. However, an excellent scheme has been arranged, by which the men toss up for their day's work every morning. In this way a man may be a moulder one morning, and a chemist the next. The foundry has only been working for a fortnight, and so far no man has had to do the same job twice. The merriment that arises when a commissionaire tries his hand at patternmaking has to be seen to be believed. When the managing director arrives, he walks around the foundry, cracking jokes, performing simple card tricks, and occasionally fixing up games of golf for the afternoon. Everybody is happy, and consequently more efficient. At 12.30 p.m. the men have two hours off for lunch, which is supplied by the management. They then have an hour's siesta (this is most important for their health), and at 4.30 they go home. The board of directors see them off at the gates, and make a point of waving until everybody is out of sight. Marksman.

Imported Iron and Steel Rolls.

HIGHER CUSTOMS DUTIES.

Under the Additional Import Duties (No. 18) Order, 1933, dated August 30, the total Customs duties on forged or cast rolls of iron and steel for rolling mills are, as from September 5, at the rates shown:—Value not exceeding £24 per ton, 33⅓ per cent.; value exceeding £24 per ton and not exceeding £40 per ton, £8 a ton, or 20 per cent., whichever is the greater; value exceeding £40 a ton, 25 per cent.

The Import Duties Advisory Committee state that forged or cast rolls of iron and steel have hitherto been subject to a duty of 20 per cent. *ad valorem* as parts of machinery. They now become dutiable at the same rate as other forgings and castings, in order to protect the home manufacturer against the uneconomic price cutting to which these goods, like other similar iron and steel products, are being subjected by foreign competition. The new duties, in common with other additional duties on similar iron and steel products, cease to be chargeable on the expiration of two and a-half years from April 26, 1932.

A Modern Australian Foundry.*

QUANTITY PRODUCTION OF PISTONS AND RINGS.

By R. G. Russell.

Following upon the growth of the automobile replacement field in Australia, the author's firm, Messrs. Russell Manufacturing Company Pty., Limited, which was already, through an allied company, Replacement Parts Pty., Limited, established as distributors of spare parts, decided in 1920 upon the creation of a quantity-production foundry specialising in the manufacture of piston castings in both grey iron and aluminium and piston rings. A site was chosen at 95, Burnley Street, Richmond, Melbourne, which was bounded on three sides by proper roads, which helped in ensuring reasonably straight line production. It will be realised that the specialities chosen are not the easiest class of castings to manufacture, and from the start a control of the raw materials was instituted by ruling out any attempt to use "bought" scrap. It should be pointed out that the author lays no claim to be either an expert foundryman or metallurgist, but an engineer who has utilised his training to further the efforts of his colleagues by close co-operation. That this co-operation has met with a reasonable success can be left to the film which will be exhibited at the end of this Paper to show.

FIG. 1.—PISTON POT BAY IN THE FOUNDRY OF RUSSELL MANUFACTURING COMPANY, MELBOURNE.

Raw Materials.

It is the policy of the firm to place orders for 1,000 tons of pig-iron at one time with the Broken Hill Company. By doing so, proper specifications can be, and are, instituted.

The requirements of the foundry are met by the creation of four grades, two of high and two of low phosphorus content, associated with four differing silicons, ranging from 1.75 to 3.5. On arrival, these are stocked in separate bins. Charges are weighed out into skips suspended from a monorail by means of an electric hoist, a spring balance being interposed between the hook of the hoist and the skip. The charges weighing 2 cwts. are taken directly to the cupola-charging platform. The coke, which comes either from the Broken Hill Company or the Melbourne Steamship Company and the limestone are similarly dealt with, except that on the cupola stage, the weighed coke is divided into charge quantities by measuring. The character of the coke is such that breaking down and riddling has to be undertaken. It contains about 10 per cent. ash, but is structurally quite strong. A melting ratio of 1 to 8 is maintained.

Melting Plant.

There are two cupolas, one of 24 in. and one of 20 in. dia., the latter being mainly used for experimental purposes and the making of synthetic irons by blending with steel scrap. The cupolas are home-made, and for their constructional details the notions set out by Moldenke and Hurst in their text-books were closely followed, except as to "height to the charging door," which shop conditions dictated must be somewhat less than standard. The Roots blower-driven cupolas, which have four tuyeres, are lined with local firebricks, patched with local ganister, and yield a metal of 1,420 deg. C. as measured by the optical pyrometer. They have a covered-in charging floor, but no spark arrester. A feature which is said by English friends to be unique is the provision of a shute down which the dust collecting in gutters can be brushed.

Foundry Buildings.

Climatic conditions are such that no glazing is necessary for the shops, nor is there need for heating, whilst obviously, ventilation is automatic. The main foundry shop, which is 100 ft. by 200 ft., is divided into two main bays, wherein the two main products, pistons and rings are self-contained units. The patterns and core-boxes used are normally of brass. They are made by local foundries, but are machined and mounted in the firm's own machine shops. They are stored in fireproof steel racks in a strong room.

Manufacture of Pistons.

The general lay-out of the bay devoted to the manufacture of pistons is shown in Fig. 1. Metal is taken from the cupola shown on the right-hand side in 2-cwt. ladles. After casting up, the moulds are knocked out in area just in front of the foreground of the illustration, Fig. 1, and the night staff pass the whole of the sand through an Axmann-Prosama thrower and heap it at the side of the moulding machine shown at the extreme left-hand side. The moulding boxes are either replaced on the conveyor or stocked conveniently near the moulding machine. In the morning, the moulder, by means of a Milwaukee jolt-squeeze pattern draw-moulding machine, makes before dinner time about 100 moulds containing either four or six castings. The sand has to be fairly strong and somewhat resembles Mansfield.

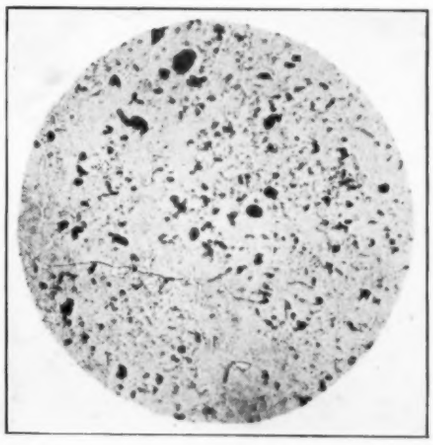

FIG. 2.—METAL MADE AT MELBOURNE FOR HIGH-DUTY IRON. × 100.

As each mould is made it is placed on the conveyor, the actuation of which is controlled by the moulder himself. The conveyor, which also is home-made, is of the simplest possible character. It consists of 37 circular cast-iron plates which slide on rails. These plates are moved at the rate of 2 ft. per min. by being attached to a Renold's chain, which is driven through gearing by a 5-h.p. motor. On the squeeze plate of the moulding machine V-strips have been attached, which allow air to enter below the mould and so aid venting. A machined cast-iron plate closes the mould, acts as a weight, and also carries the runner bush. The coring up is also done by the moulder, the cores themselves being made by boy labour, by hand, from a mixture of wind-blown river sand

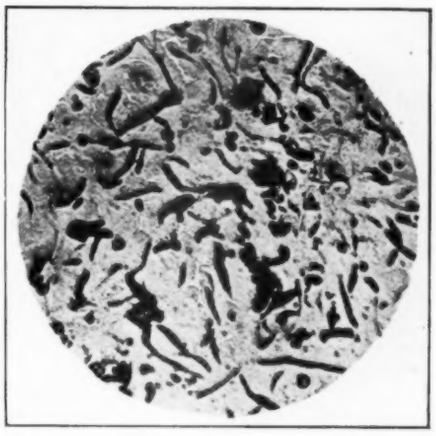

FIG. 3.—METAL MADE IN AMERICA FOR THE SAME DUTY AS FIG. 2. × 100.

* Paper presented last night to the London Branch of the Institute of British Foundrymen.

mixed with boiled linseed oil and flour. At the time the author left Australia, tests were being made with dextrine as a substitute for flour.

The core-boxes are held in air-vibrated vices which have been designed by the author. They are baked in an oil-fired oven transferred to a revolving table and sprayed with plumbago. The blacking is stored in an overhead tank,

Fig. 4.—Single Cast Piston Ring Bay—Russell Manufacturing Company, Melbourne.

where it is mechanically agitated and fed by gravity through piping to the revolving table where an ordinary type of paint sprayer is used, the drainings being returned manually to the tank. The cores are made as a single piece and are suspended vertically by a V core-print into the moulds. Rejects, after very rigorous inspection, vary from 5 to 10 per cent. A typical composition is T.C. 3.5; Si 2.3; Mn 0.7; S 0.08 and P 0.2 per cent. In Figs. 2 and 3 are shown examples of metal made by the author's firm and an iron made by an American house for a similar duty. In Fig. 2 an unetched specimen at 100 diameters shows the metal (Si 2.2; Mn 0.85; S 0.09; P 0.23; Ni 0.7 and Cr 0.2) to have its graphite in an extremely fine state of division and well dispersed. Fig. 3, taken under identical conditions, has fairly coarse graphite flakes.

It may be of some interest to note that silicon adjustments are made by use of the pure metal and by incorporating ferro-silicon, as it was found that the latter alloy introduced a certain amount of dirt.

Fettling and After-Treatment.

The castings are stripped while still hot, and transferred to the fettling benches. The cores leave the casting fairly easily, but they are subjected to a blast at 100 lbs. pressure, the dust being taken away through an aperture in the wall to a central dust-extracting plant. This plant, driven by a 20-h.p. motor, also exhausts the dust from two double-ended grinders using either British Norton or Carborundum wheels installed in the fettling shop, and in addition serves all the precision grinders. The dust is finally drawn through a 14-in. pipe leading into a fairly large chamber, where the speed is considerably reduced. The blast passes through a series of perforated baffle plates down which a stream of water flows and converts the dust into sludge. This collects in a tank at the base of the chamber and is drawn off from time to time.

The pistons then undergo a short heat-treatment in an oil-fired stove, where they are submitted to a temperature of 800 deg. C. for two hours. After passing the Brinell test, which is controlled at 220, they are machined all over the outside, and taken to the despatch stores.

Piston-Ring Manufacture.

This work is carried out in a separate bay of the foundry, which is shown in Fig. 4. Moulding is carried out on three moulding machines, two Milwaukee and one Osborne. These machines are served by four gravity roller tracks, with a monorail for carrying the molten metal arranged above and between the outer sets. Sand is prepared in an adjacent shop, furnished with a 6-ft., 4-ft. and 3-ft. 6-in. pan mills, the smallest one being used for the mixing of oil sand mainly for the piston department. It is fitted with a serrated bottom plate to prevent caking. For the piston-ring castings, a type of sand known as "brass" sand is used, and after melting is passed through gyratory riddles carrying a $\frac{1}{8}$-in. mesh placed conveniently at the side of the moulding machines. The boxes used for this class of work are but $1\frac{1}{4}$ in. deep. They are threaded through their lugs on to two rods, attached to a machined baseplate by a man and boy; this system ensures a correct and continuous register for the 13 to 18 boxes which go to form a stack. These stacks are built up on the roller conveyor and pushed along by hand. The runner bushes are made of baked oil-sand cores and have no containing boxes. The system of running piston rings presents several features of interest from both the foundry and metallurgical point of view. No matter whether the box contains four or more rings, the same system is adhered to. Primarily, there is the central stalk connecting all the boxes of the stack. From this there are four ingates leading into a circular reservoir, the outlets from which are not opposite but between the ingates. The liquid metal then fills the rings, and where the two streams of metal meet, a blind riser or pip situated sometimes internally and sometimes externally serves the dual purpose of maintaining a reservoir of heat where chilling might be expected, and to carry away from the mould proper any speck of sand entrained in the

Fig. 5.—Die-casting Shop—The Russell Manufacturing Company, Melbourne.

Fig. 6.—Air-circulated Electric Furnace for Heat-treating Aluminium Pistons.

metal. It is sometimes put forward that because of ferro-static pressure the castings in the bottom box will be of greater density than those contained in the uppermost. A moment's consideration, however, will show that owing to the relatively small cross-sectional area of this type of casting, rapid freezing effectually precludes any such influence. The castings are fettled by barrelling, using recently-cast "pips" as "stars." The composition of the rings is controlled at T.C. 3.5, Si 2.9 to 3.1, Mn 0.6 to 0.8, S 0.08 and P 0.6 per cent. The order of melting is first the provision of metal for the pistons, then the separation period carrying the usual double coke charge, a few casts of jobbing castings for the factory maintenance jobs and finally the piston-ring metal. The output is of the order of 10,000 rings per day, the moulders putting down 130 moulds per hour containing 4, 6 or 8 castings.

Fig. 7.—Brinell Testing of Pistons.

Fig. 8.—View in Works Stores.

Aluminium Pistons.

For the requirements of the aluminium die-casting foundry 4 tons of the virgin metal reaches us from the British Aluminium Company each month. No remelted metal ever enters the foundry, whilst the machine swarf is sold to metal dealers. On receipt, the metal is alloyed in Morgan D 66 crucibles in oil-fired pit furnaces with 1.25 per cent. Si, 0.35 per cent. Mg and 9 to 11 per cent. copper. For use in the die-casting shop, which is shown in Fig. 5, the alloy is maintained liquid in oil-fired iron pans. As will be seen from the illustration there are three machines, each operated by one man, who will cast about 200 per day. The runners are cut off by band-saw. At this period the pistons have a Brinell hardness of 107. The castings are then heat-treated in a Genhrich electric oven, provided as is shown by Fig. 6, with internal air circulation. Its temperature is recorded by a Leeds-Northrup pyrometer. The treatment consists of maintaining the castings for 5½ hrs. at 300 deg. Fah. (150 deg. C.). After this treatment the Brinell hardness is increased to 120 to 130.

Fig. 9.—View in Despatch Stores.

Fig. 10.—Window Display showing the Products made in the Russell Foundry.

Conclusion.

The author's firm possesses modern chemical and microscopical laboratories, and makes strenuous efforts to supplement its technical control by efficient commercial services. Its associated company, the Replacement Parts Company (Pty.), Limited, it should be understood, has to cater for the appropriate spare parts for all the various types of automobiles entering the Australian market. This service even includes the designing of window displays for garages and stores catering for this class of business. The products are marketed under the trade name of "Repco."

In conclusion, the author wishes to express his appreciation of the help accorded to him by Mr. V. C. Faulkner, the Editor of The Foundry Trade Journal in the preparation of this Paper, which to the author has been something in the nature of a holiday task.

Import Duties.

Additions to Free List.

The Import Duties (Exemptions) (No. 9) Order, 1933, adds the following commodities to the Free List as from September 2:—Nickel-copper alloys containing more than 60 per cent. by weight of nickel; unwrought tin metal.

The only nickel-copper alloy of any commercial importance containing more than 60 per cent. by weight of nickel is Monel metal. The use of this metal is still in an early stage of development. It is produced exclusively in the United States of America from a natural alloy found in Canada. The total United Kingdom consumption is not at present sufficient to warrant the laying down of the expensive plant required for its production in this country.

An important *entrepôt* trade in Straits Settlements tin is conducted in London, but as one-third of the ore smelted is drawn from the Dutch East Indies, this trade is being adversely affected by the diversion to foreign ports of consignments of metal which fail to satisfy the conditions governing Imperial Preference. The largest smelting interests in the country have expressed themselves in favour of the removal of the duty on unwrought tin metal, which has not been opposed from any quarter.

Quantitative Separation of Zinc and Iron.—In the "Analytical Edition" of "Industrial and Engineering Chemistry," F. G. Hills deals with the quantitative separation of traces of zinc from large proportions of iron by precipitating the zinc as zinc sulphide from a solution made weakly acid with sulphuric or formic acid. The analytical procedure is given in full.

Resistant Chromium Coatings.—The heating of electrolytically-deposited chromium coatings to a high temperature to induce their diffusion into the metal is not successful in practice, as before the requisite temperature is reached the coating commences to peel. Even high heat-resisting coatings cannot withstand temperatures above 800 deg. at which point no diffusion takes place. Porosity and the peeling of deposited coatings are thus not eliminated by modern electrolytic methods. According to a new patent of the I. G. Farbenindustrie, the adhesion of chromium coatings may be considerably improved by using an intermediate deposit of nickel or cobalt between the chromium and the base metal, and subsequently heating the coated product in a neutral atmosphere at a temperature at which the intermediate layer does not melt, but the coatings are given an opportunity for reciprocal diffusion.

Standard Files and Rasps.—The British Standards Institution has issued British Standard Specification for Engineers' Files and Rasps (B.S.S. No. 498—1933). Whereas originally there were some thousands of different sizes and types of files, the Standard Specification provides for only 234 standard files of 24 different types, and the views of industry indicate that these are sufficient to meet the normal demands of engineering. The specification is in two parts. The first part is devoted to nomenclature and a description, together with an illustration, is given for each different type of file. The second part of the specification includes 29 tables giving the overall dimensions and the number of cuts for the various types. Tolerances, on both the dimensions and number of cuts, are laid down in the specification. Copies of this specification may be obtained from the Publications Department, British Standards Institution, 28, Victoria Street, London, S.W.1. (Price 2s. 2d. post free.)

Alloyed Grey Cast Iron.

PRESENT POSITION OF MARTENSITIC AND COPPER-BEARING IRONS.

Dr. Pfannenschmidt's Paper* to the Cardiff Conference well maintained the high standard we have learnt to expect from German metallurgists. The principal features of the discussion ranged around martensitic cast iron and the influence of copper.

The discussion was opened by the President, Mr. C. E. Williams, who, after expressing thanks to Dr. Pfannenschmidt for his Paper, and for having travelled from Cologne to present it, said that the marriage of copper to tin, by the foundryman, was a wonderful event, but the foundryman is now marrying grey iron to copper, and one was astonished at the remarkable results effected by a small percentage of copper. One of the great troubles of the world was the enormous wastage of metals, which Sir Robert Hadfield had said was more than 48 million tons a year. It seemed, however, that as we learned more of the remarkable influence of copper we should be able to prevent much of this wastage.

Principles of Alloying.

Mr. F. K. Neath, B.Sc., in congratulating the author, said that a particularly valuable feature of the Paper was that not only had the author given an account of his own tests, carried out on a works scale, but had at the same time dealt with other people's work in such a way as to render it unnecessary to read a good deal of the technical literature in order to compare his work with theirs. Many workers had added various alloys to cast iron, in large and in small quantities, and it was a remarkable fact that when practically any alloying element was added, in small percentages—say, 1 or 1½ per cent.—to a given cast iron, nearly always there was a slight increase in mechanical properties, of the order of 10 or 15 per cent., and no further improvement occurred with higher percentages. That seemed very strange, and it had occurred to him that probably such an increase was due, not to the value of the alloy additions themselves, but to the fact that invariably they were added as a ladle addition, as the result of which some refining or de-gasifying or other process occurred in the metal. In regard to the addition of some of the alloys, such as nickel, chromium and molybdenum, the influence of these elements had been worked out fully, and very valuable results could be obtained, but it was a fact that the addition of any alloy to cast iron seemed to effect some slight improvement.

In a graph showing the relative growths of test-pieces at 650, 750, 850 and 950 deg., it appeared that there was a decrease in volume at about 950 deg. C. Mr. Neath asked if that were due to the fact that at 950 deg. C. the melting point of the phosphorus constituent was approached—all the irons contained 0.3 or 0.4 per cent. phosphorus—and whether that had any influence, due to squatting of the bars.

Growth Tests on Cast Iron.

Dr. Pfannenschmidt replied that in Germany specimens, which differed markedly in respect of phosphorus content, were tested for growth in the furnace, both in the loaded and the unloaded condition. In the loaded specimens the effect of the melting of the phosphorus was very marked, and, therefore, the growth seemed to be less.

Discussing the improvement of transverse and tensile strengths of grey irons, he gave figures to show the improvement in rotary bending strengths as the result of alloying; in some cases alloying improved the rotary bending stresses from 12 to 19 kg. per sq. mm. There, in his view, lay the marked influence of alloying elements; alloying of grey irons would not give the irons very markedly high tensile strengths, but would enable the manufacturer to reduce the thickness of castings, which was an important matter in the motor industry, particularly having regard to the question of price. For some years work on this problem had been carried on at the Technical High School at Darmstadt; whilst the Humboldt-Deutz Company was operating; if the experiments, which were repeated often, were proved to give true results—and there was no cause to think otherwise—then it would be possible to make motors in grey iron having very much less weight per h.p.

Use of Martensitic Cast Iron.

Dr. Everest, in expressing appreciation of the Paper by Dr. Pfannenschmidt, complimented the author, not only on the technical quality of all the data given, but also on the admirable manner in which he had succeeded in presenting the Paper in English. He spoke with some little experience of giving Papers in foreign countries and knew the difficulties of making oneself clear on a technical subject under such conditions.

Referring to the various points raised in the Paper, Dr. Everest pointed out that extensive reference had been made to the use of various alloys for improving wear, and it was very interesting to note the excellent results obtained with the molybdenum alloy cast irons. He would like to ask the author, however, whether any experiments had not been carried out in Germany on the martensitic types of cast iron in which the special structure is obtained either by the use of alloys, such as nickel and chromium, or by heat-treatment. Experience in Great Britain seemed to point to the fact that, for resisting straight abrasion, the martensitic structured cast iron seemed to offer the best results, castings such as cylinder liners proving in service at least twice as good as the more ordinary materials. He was, therefore, rather surprised that, in Dr. Pfannenschmidt's Paper, no reference whatever was made to irons of this class.

In connection, further, with the high-hardness cast irons, Dr. Everest pointed out that the hardness figures shown in the Paper were, in his opinion, many of them on the low side. For example, it was mentioned that the martensitic structure in cast iron shows a Brinell hardness of only 350. In his (Dr. Everest's) own experience, he had found that in irons, both martensitic "as-cast" and martensitic by heat-treatment, very much higher hardness values could be obtained, and figures of 500 or over had been quoted by such workers as Mr. Hurst as well as in his own researches. In Great Britain it had been found that, under good conditions, these higher hardness irons could be comparatively easily machined, and he mentioned in this connection that cylinder liners with a hardness of close on 400 were being regularly machined on a commercial basis.

General Influence of Alloys.

Referring next to the point raised in the discussion by Mr. Neath concerning the general use of alloys in cast iron and their influence on strength, Dr. Everest confirmed that, on straight test-bars, it was often difficult to show any marked improvement in strength as a result of the use of alloy additions. Where improvement was found it was generally of a relatively low order, such for example as less than 10 per cent. The value of alloys, however, in cast iron lay in their effect on equalising the structure, and so giving greater uniformity and reliability in production. It was in the light of these other effects that the influence of such elements as nickel must be considered, and, when such dominating factors as machinability in castings of varying section were taken into consideration, then the full value of alloy additions in enabling hard irons to be used was appreciated, and was found to result in markedly higher strengths and better properties in those parts of the castings required to stand up to severe conditions.

Corrosion Resisting Irons.

The speaker next referred to the corrosion-resisting austenitic cast irons, and mentioned that he did not agree with the statements made on page 18 of the reprint, in connection with the influence of copper on corrosion resistance. It was stated that the addition of copper to an iron containing 12 per cent. of nickel resulted in a marked improvement in resistance to acid attack, but he contended that this improvement was illusionary, since an iron containing 12 per cent. of nickel would not be fully austenitic, and, no matter what alloys were present, a mixed martensite-austenite structure did not give good corrosion resistance. All the copper addition had done in this case had been to render the structure of the iron fully austenitic, and a corresponding improvement in corrosion resistance would have been found had any other austenite-forming metal been added, since, in his opinion, the inherent structure of the metal, that is to say, whether it was martensitic or austenitic, had a far greater influence on the corrosion resistance than did the presence of one or other alloy addition, and the value of the latter lay primarily in the assistance they give us to obtain and control these special structures.

Referring to copper, experience seems to show that copper of itself in the austenitic irons has no great outstanding value from the point of view of pure corrosion resistance. It is frequently included to replace part of the nickel for economic reasons, but, where the best properties are required, experience has shown that the copper-free high-nickel-chromium alloys are the best from the point of view both of acid and alkaline attack, and that the presence of copper tends to give less satisfactory results.

Influence of Nickel on Wear.

Dr. Pfannenschmidt, in the course of his reply, said that when his company had first made liners for lorry Diesel engines, there had been some difficulty because the high pressure in the combustion space resulted in a certain amount of wear; but when quite small percentages of alloying materials were added, the liners would stand up to their work without exhibiting a degree of wear markedly higher than that occurring in the common benzol motor. In his shops a material having high Brinell hardness was not desirable, because the object was to make a good product cheaply, and it was found that a material having the high Brinell hardness that was obtained by quenching or by adding relatively high percentages of alloying elements was more costly to machine. His company endeavoured to make a good wear-resisting iron having a Brinell hardness of only about 240, 250 or 230, in order that the machining should not be more expensive than that of any other engineering iron; and they could guarantee Diesel engine liners to last 50,000 kilometres.

Heavy Castings and Cost of Alloying.

Mr. A. Marks, commenting upon the author's reference to the question of cost, which had led to the adoption of the utilitarian Brinell hardness of 230 or 240, recalled that some years ago, when he was metallurgist to Messrs. Harland & Wolff, he had investigated the problem of alloying irons for big Diesel engines, by adding nickel, molybdenum, etc. When one came to count the cost of casting a Diesel engine liner

* Foundry Trade Journal, August 3, 1933, page 61.

of 850 mm. diameter, and found that machining could only be done economically when the Brinell hardness was about 240, one had to leave out some of the expensive alloying elements. Although one could perhaps afford alloys in an automobile cylinder or other small units, one could not afford them in big units. If one examined the various factors involved, one realised that the carbon content was the factor to be controlled, and it was controllable in an inexpensive way. He pointed out that one small speck of graphite under the ball in the Brinell testing machine would vary the Brinell hardness reading by a considerable amount. There was no doubt that alloy irons had advantages from the point of view of resistance to corrosion, but from the engineering point of view it must be remembered that the endeavour was always being made to increase machining speeds; if the wear resistance of the material was to be maintained, however, the machining speed could not be increased.

Again, figures were given from time to time to represent resistance to wear; but, of course, wear depended upon lubrication. He had driven various automobiles in this country, in the United States and in other countries, under all conditions, and one could not obtain at every garage an oil which was suitable for the particular engine one was using. He had made wear tests under dry conditions, and when using standard lubricants, and he had from time to time laid down specifications for lubricants to be used in Diesel engines. Sometimes piston rings were so treated that they became scrapers. He felt very strongly about the alloying problem, and considered that often the engineering side of the problem was not fully appreciated by the metallurgist; he had never seen published references to the oils to be used in wear tests. One could specify an oil which would reduce wear by 50 per cent., and a satisfactorily designed piston ring would also reduce the wear by that amount. If metallurgists would deal with the structures of the piston rings as well as the Brinell hardness and the structure of the cylinder liners, we should be able to discuss with more profit the value of alloys in cast iron.

Mr. J. H. Cooper said that without question copper had a beneficial effect upon the wear of iron; that fact was well known in this country, and many of the best grades of Swedish pig-iron contained a percentage of copper. There was much to be said for the addition of copper to iron from the point of view of wear, just as there was much to be said for the addition of certain proportions of manganese to steels. There might be advantages in respect of physical properties, and the reduction of the scraping effect by alloying cast iron might be beneficial.

Wear and Lubrication.

Dr. Pfannenschmidt said he did not deny, of course, the value of lubrication. At the same time, he referred to some experiments in which engines were run in a shop having a dust-laden atmosphere, a large propeller being used to ensure that the air which went into the engines contained dust. In one case the iron of which the cylinder liner was made was alloyed with molybdenum, and in the other case the iron was unalloyed, and in both cases the wear was much higher than when the engines were run in a clean shop; but the wear on the liner made of alloyed iron was very much smaller than the wear on the unalloyed iron liner, so that it was clear that alloying was advantageous.

With regard to price, that of liners of 500 kg. net weight is up to 17 pfennigs per kg.—about 1d. per lb. At this price his company had to guarantee 18 to 19 tons per sq. in. tensile strength on a test-piece cut from the liner. When working to such prices one had to consider very carefully whether or not alloying would pay. His company did not make cylinder blocks, so that he was unable to give information in that connection. But some two years ago they had made their own piston rings, from a kind of liner. The limits of Brinell hardness for these piston rings were very narrow, and at first they were unable to keep within the limits for the upper part of the liner. The diameter was 6 in. to 1 ft. 9 in., and the upper part, of course, was much harder than the bottom part. A nickel content of 0.4 per cent. was used, and the machine-shop manager had told him that he had been able to reduce wages costs by 20 per cent. All the hard spots on the surface were eliminated. That was a case in which alloying did improve the machining qualities.

Corrosion and Abrasion.

Mr. T. R. Twigger, commenting on Mr. Marks' reference to piston rings being made of hard centrifugal iron and acting as scraper rings through having sharp edges, said that Mr. Marks must have got hold of something very exceptional; certainly it was not the usual experience that centrifugally cast iron caused excessive cylinder wear, otherwise such material would never have been used on such a widespread scale for at least the last 10 years. Mr. Twigger asked if Dr. Pfannenschmidt had any views to express as to the influence of corrosion on cylinder wear, for this was a matter which had come very much to the forefront in this country during the last few months. The opinion was coming to be held rather definitely that a good deal of the wear on the upper parts of cylinders was due to corrosive products of combustion, and it would be interesting to know if that opinion were held on the Continent as well as in this country. Mr. Twigger did not think that the wear could be due entirely to such corrosive products; abrasion must enter into the problem to a very considerable extent.

He also asked if Dr. Pfannenschmidt had experimented with martensitic iron, in the form of liners, because in this country the use of martensitic liners was growing considerably. While in some cases a high-nickel iron was used, the more general practice was to use a low-alloy content iron rendered martensitic by heat-treatment. Whilst it was quite impossible, of course, to obtain that condition in the ordinary cylinder block, it was very definitely possible in liners, and method was being adopted to an increasing extent, especially in the commercial-vehicle field.

Dr. Pfannenschmidt said he had found that in all cases the use of copper resulted in affording excellent resistance to corrosion and to wear.

A message of good will was conveyed to the conference by Dr. Pfannenschmidt on behalf of German foundrymen.

The President asked Dr. Pfannenschmidt to express to the Institute's friends in Germany its appreciation of their message, and to convey to them a reciprocal message of good wishes. He also proposed a hearty vote of thanks to Dr. Pfannenschmidt, and to his firm—the Humboldt-Deutz Motor Company—for having permitted him to give the information contained in the Paper, and which was largely the result of their own experiments. The Institute, he said, was very appreciative of this kindly act on the part of its German friends.

The vote of thanks was carried with enthusiasm.

(*Concluded from next column.*)

Hoddle also have really interesting exhibits. To see whether a weld or a casting is satisfactory, one must have recourse to X-rays, and this can be accomplished at Olympia by calling at the stand of Phillips Lamps, who are specialising in the provision of such apparatus. A range of patternmaking machinery is being shown by the Dominion Machinery Company, Limited, whilst air compressors, the prime movers of the foundry industry, are being shown in the latest designs by Reavell & Company, Limited, Broom & Wade, Limited, and many others.

The Shipping, Engineering and Machinery Exhibition.

This exhibition, which is to be opened to-day (Thursday) by the Earl of Athlone, is of peculiar interest to foundrymen, because a very high percentage of the exhibitors are foundry owners having a high reputation for the quality of their castings, such as Hall of Dartford, Stone of Deptford, Dewrance, Allen of Bedford, Parsons of Newcastle, Thornycroft of Southampton. In the direction of special grey-iron castings, there is Sheepbridge Stokes, who, in addition to showing centrifugally-cast material, have this year added alloyed cast iron. A stand which is certain to attract the foundryman is that of the Mond Nickel Company, as invariably they have something new to tell of the development of alloyed cast iron. A newcomer to the field of improving cast iron is the International Meehanite Company, Limited, and all are anxious to learn in what way the process supersedes the methods already practised in Great Britain. It has an excellent reputation in the United States. Then the British Cast Iron and British Non-Ferrous Metals Research Associations are showing on the stand organised from the Department of Scientific and Industrial Research. These are of much the same character as was shown at the recent foundry exhibition, but the former has added a wonderful wire model of the iron-carbon-silicon diagram which has been constructed under the supervision of Dr. Hanson, and embodies all the most recent points established by scientific research.

In foundry equipment, there is a very representative display of portable tools. Sir W. G. Armstrong, Whitworth & Company have a fine display of pneumatically-operated tools for both the moulding floor and fettling shop. The tools shown by F. Gilman (B.S.T.), Limited, are also interesting for those desiring to modernise their fettling shops.

As it is now fashionable to heat-treat so many kinds of castings, advantage should be taken of this exhibition to inspect the furnaces shown by the Birmingham Electric Furnaces, Electric Resistance Furnace Company, Gibbons-Wild-Barfield Electric Furnaces, Limited, and Incandescent Heat Company. The modern electric resistance furnace has an air circulator, as obviously stationary air is a bad heat conductor, and the newer furnaces are very much more efficient.

Pig-iron of the "special" variety is to be found on the stands of British Pigirons, Limited, Bradley & Foster and Armstrong Whitworth. The manner in which these firms help the British foundry industry to keep abreast of metallurgical developments is indeed commendable, and, apart from the cheery welcome one receives at the stands, one is bound to pick up some worth-while information of a technical character. Foundry Equipment, Limited, are not showing foundry equipment, unless one includes pulley blocks in this category, but if one chances to meet Mr. Corrie, Mr. Beech or Mr. Tichelly on the stand, they will not be adverse to talking "shop."

The attitude of founders towards welding is changing rapidly, and if only the big buyers like the Government departments would exercise a more reasonable attitude, the dissemination of its technique as related to curing of surface blemishes would be enhanced. At Olympia there are some excellent stands devoted to this activity. The stand of the British Oxygen Company is particularly intelligently organised, and in addition to welding includes metal spraying. Founders should get to know more about this process, as we have recently encountered in various foundries a number of jobs well worth while being coated by this means as an aid to appearance and corrosion resistance. Murex Welding Processes, Limited, and Thorn &

(*Concluded in previous column.*)

New Mechanised Plant at the Holwell Works of The Stanton Ironworks Company, Limited.

By Vincent C. Faulkner.

The new mechanised foundry installed by The Stanton Ironworks Company at their Holwell Branch registers a real advance in foundry practice as applied to pipe special castings. It was put into commission on January 1, 1932, and has operated since that time with a freedom from mechanical breakdowns and snags, which is truly remarkable. Like other similar plants, it emphasises the need and usefulness of practical gadgets and tricks of the trade, which characterise the efforts of the smart jobbing foundry foreman. Familiarity with the conduct of mechanised foundries gives the lie direct to those who assume that their construction and operation is the exclusive province of the mechanical engineer and metallurgist. The great difference between the application of *tours de main* in the Jobbing Shop and the mechanised foundry is that their value can be registered in the latter case as definite monetary savings, whereas in the former they pass almost unnoticed.

The general lay-out of the foundry is shown in Fig. 1, and to obtain a proper perspective of its functioning it should be pointed out that it makes but two types of pipe specials for normally a period of one week. When the plant closes down on a Friday night the patterns are changed. Moreover, it should be realised that embodied within the plant is the core-making department.

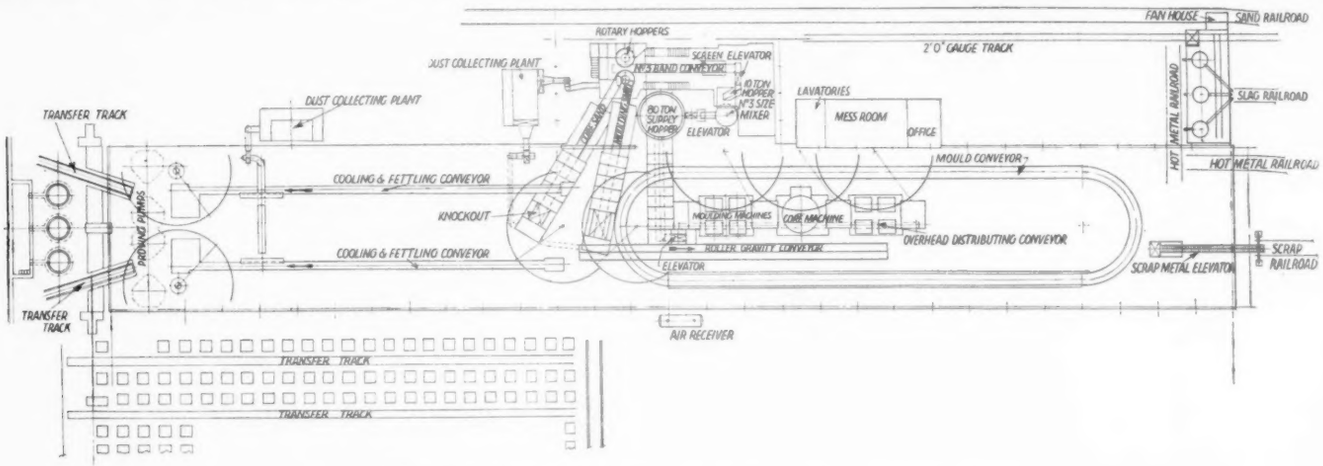

FIG. 1.—GENERAL LAY-OUT OF THE MECHANISED FOUNDRY AT HOLWELL WORKS.

The Sand Circuit.

Experience has taught us that descriptions of mechanised plants are more intelligible if its description starts at the knock-out. Where shown in Fig. 1, the boxes are knocked out by means of a vibrator attached to a crane, and the empty boxes are picked up by an air-hoist and returned to the moulders by a double line roller gravity conveyor, 108 ft. long. The castings are taken to a second knock-out station, where the core sand is liberated. The castings are then placed on two creeping slat conveyors, which comprise the fettling department, where they are thoroughly fettled, and to which reference will be made later.

Sand from both the knock-outs falls through grids on to inclined rubber-faced belts 2 ft. wide, which carry it underground out of the foundry into the sand-preparing shop. Here it is delivered into the hopper shown on Fig. 2. The companion hopper holds the new sand. It will be gathered from the fact that the core sand is incorporated with the bulk that it is of the same character as the moulding sand. Moreover, like most mechanised foundries, the system sand is of such a quality that no special facing sand has to be used. These hoppers are provided with rotating circular bottoms adjustable so as to regulate the efflux of sand which feeds the sand on the band conveyor shown in Fig. 2 and in Fig. 1 as feeding the rotary screen. The ratios of old and new sand to be incorporated in the system sand are therefore controlled at the discharge points of these two hoppers. After screening, any tramp iron is removed by passing the sand over a magnetic separator. The sand is then elevated to fill a ten-ton capacity hopper from which a batch measurer feeds a No. 3 Simpson intensive mixer. Here carefully-measured

FIG. 2.—VIEW IN THE SAND-PREPARING ROOM.

proportions of coal dust and water are added. As the time of mixing is also controlled, a definite quality of sand is maintained day after day. The sand leaving the Simpson mixer is elevated to an 80-ton capacity storage hopper seen on the right of Fig. 2. This discharges at its base a regulatable quantity of system sand which passes by means of an underground band conveyor shown as "No. 3," Fig. 1, to the interior of the moulding and core-making plant as defined by the mould conveyor. Here it is elevated and discharged through a disintegrator upon the overhead sand-distributing conveyor. Ploughs run over the sand to fill these hoppers situated immediately above three stationary sand slingers. If the hoppers be full, then, at its end, the distributing conveyor discharges any surplus down a shute shown at the extreme right of Fig. 3. Beneath this and running in the opposite direction to the distributing conveyor is the subterranean spill band-conveyor, which returns what is, after all, perfectly good surplus sand and spillings from the moulding machines which reach it through floor-level grilles. After being incorporated into moulds, the sand is after casting up returned to the sand-preparing department *via* the knock-out.

Moulding and Coremaking.

The provision of patterns and core-irons is one which has received a maximum of intelligent thought on the part of the technical direction. At first thought, one would have imagined that a separate core shop would have been created, that the cores would have been made from oil-sand cores, that they would have been stoved, and conveyed to the moulders. These numerous and expensive operations have been minimised by utilising green-sand cores made on the centrally-situated sand slinger, followed by squeezing in the hydraulic press, designed by Stanton and made by Davey Brothers, Limited, shown at the centre of Fig. 3. When compressed, these cores are a really excellent job, and our examination of the castings during a fairly prolonged period of manufacture failed to reveal a single core below.

Because of the incorporation of a magnetic separator and the silky nature of the sand, the sand slingers are working particularly smoothly. Specially-designed boxes taken from the gravity-roller conveyors are placed over the patterns, one of which is shown on Fig. 3, mounted on a Jackman stripping machine. It is rapidly rammed by the sand slinger, and for the top parts, a cast-iron section of a hollow core is inserted and later withdrawn to form the runner basin. This is one of the minor details, such as are evolved daily by the skilled moulder in the jobbing shop, which there, because of the "one or two off" nature of the work is more or less lost, but which in a mechanised foundry can be credited with a considerable annual monetary saving. We stress this small detail because only too often the highly-skilled moulder imagines there is no place for him in shops of this type, whereas whilst quantity is no longer necessary in quantity-production shops, quality is still a prerequisite.

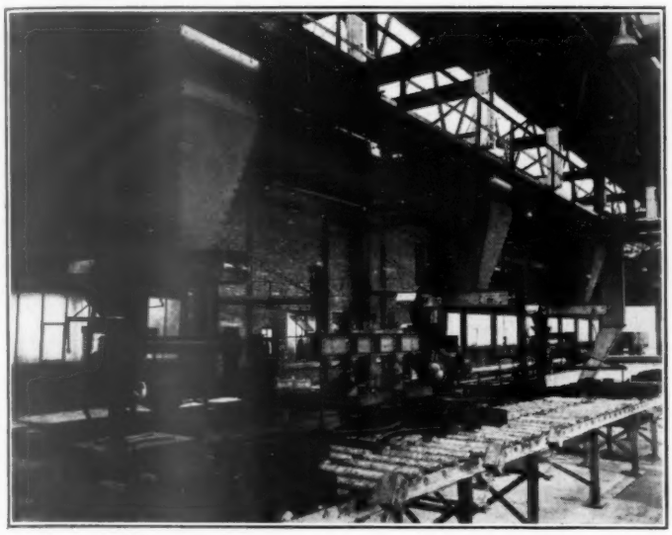

Fig. 3.—General View of the Mechanised Foundry at Holwell.

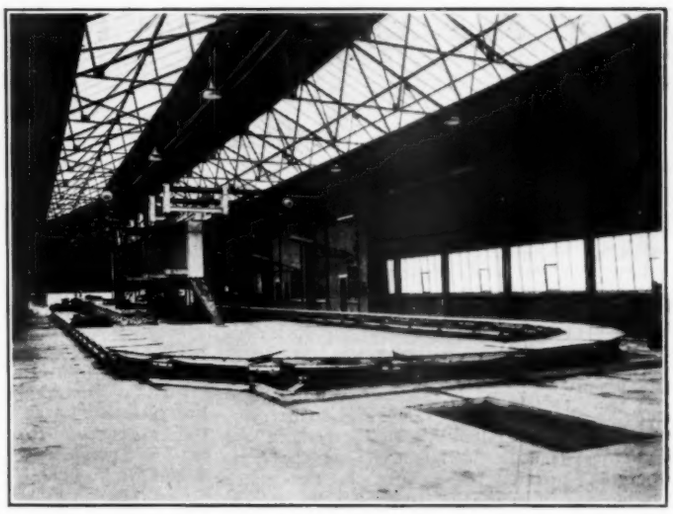

Fig. 4.—View of the Plant from the "Hot Metal" End.

The moulds on the mould conveyor are assembled as carefully as in any jobbing shop, the men having available hoists to eliminate the donkey work. This conveyor, which is 400 ft. long, is August's double bogie type and weighs 80 tons. It has a load carrying capacity of over 150 tons. On each section, it is now the custom to spread a layer of sand for the dual purpose of preventing the cracking or warping of the plates and for eliminating too light a fit between plate and box and so allowing more natural venting to take place after casting.

Metal reaches the shop at the end remote from the knock-out and fettling from a cupola plant serving foundries additional to the mechanised plant. It is, however, proposed to instal a melting plant within this department in the near future. From Fig. 4, which gives a general view of the plant, the conveyor shown goes in clockwise direction. The ladles of liquid metal are suspended from the monorail shown between the side and top lights. The runners are thrown into the hole shown in the right foreground, which carries the scrap metal elevator, shown in Fig. 1. This discharges the metal in a wagon for return to the cupolas.

The cast-up boxes pass through a long, well-ventilated totally-enclosed chamber where the casting fumes are drawn off and the sand is allowed to cool. It has been constructed subsequent to the taking of the photograph shown in Fig. 4. Its effectiveness is shown by the relative absence of steam at the knock-out station. If the cooling of the cast-up boxes be not properly effected, two serious inconveniences can arise. One will be a natural desire to clear up the atmosphere around the knock-out station by the provision of a too fierce a forced draft evacuating canopy, with the result that the coal dust will be drawn out of the sand. The second will be the return of sand to the sand-preparing department at too high a temperature, which involves numerous troubles. At Holwell we are satisfied that the mould cooling is doing its job thoroughly.

Fig. 5.—View of the Coring-Up Section of the Conveyor.

Fettling.

The castings leave the knock-out station along the two creeping conveyors of the type shown in Fig. 6, which illustrates the end remote from the knock-out. These conveyors are 130 ft. long and 2 ft. 6 in. wide. At the time of our visit the management were planning to speed-up production by the incorporation of some form of sand blast. At the end of the line the pipe specials are tested for soundness under water pressure, then dipped in a bituminous solution and stocked in a position convenient for despatch, as shown in Fig. 7.

(Concluded on page 137.)

Fig. 6.—Creeping Conveyors up which the Castings are Cooled and Fettled.

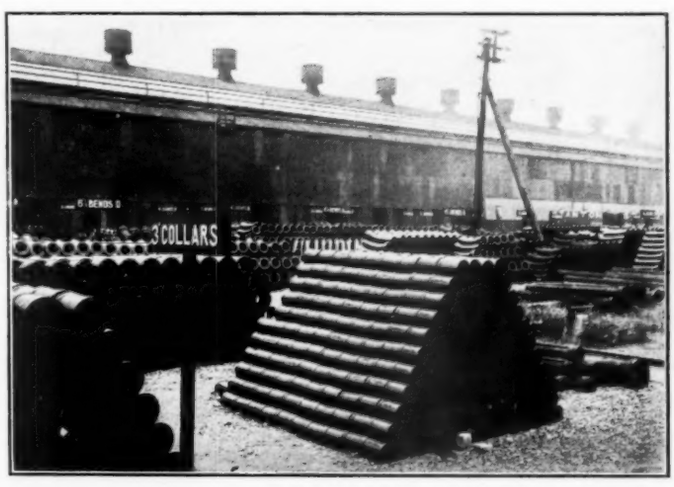

Fig. 7.—The Stocking Ground is Conveniently Placed for Shipping and well Organised.

Report on Routine Methods for Testing Green Sands.

SAND TESTING METHODS EXAMINED.

A Call for Standardised Methods.

The Report prepared by a Committee of the Institute of British Foundrymen was well received by the Cardiff Conference, but there was a desire expressed for definite recommendations to be tabulated. For instance, Mr. Thos. Tyrie, Kilmarnock, in a written communication, expressed his appreciation of the work done by the Sub-Committee on a subject of paramount importance to foundrymen. As one who had been actively engaged in sand control for several years he appreciated the difficulties to be overcome before recognised standard methods for testing sands could be adopted. At the same time, he expressed regret that the Committee was not yet in a position to recommend a definite set of apparatus for the determination of permeability, or a definite size of test-piece for determining permeability and bond strength. Had such been possible, and had the Paper embodied a detailed account of the Committee's recommendations, its value would have been greatly enhanced; however, he hoped that such a step would be possible at an early date. The Paper discussed briefly different types of apparatus, but left the reader to select his own fancy —an unsatisfactory position for the foundryman or metallurgist with no great scope for experimenting, and one which was not destined to lead to standardisation of methods, which was so greatly needed in this and other countries if real progress were to be made.

Discussing the B.C.I.R.A. bond or compression-testing apparatus, Mr. Tyrie said his experience had convinced him that a dummy pointer should be fitted to the spring balance supplied, as the collapse of the test-core was so sudden that an accurate reading of the pointer was impossible unless several tests were conducted. With the aid of a dummy pointer the exact strength might be read off with ease. Balances were supplied with the dummy pointer on request, but Mr. Tyrie warned prospective purchasers that the dummy pointer, as supplied, was much too stiff, and required a force of from 2 to 3 lbs. to move it. This meant that the test-core was under a strain of from 2 to 3 lbs. before any reading was obtained, and a false reading resulted. Furthermore, it was necessary to prevent sand getting on to the spindle carrying the dummy pointer, as this could cause unnecessary friction, with misleading results. It was advisable to test the balance periodically by dead-weight loading to ensure satisfactory operation.

Richardson's Apparatus.

Discussing Richardson's modification of the A.F.A. permeability apparatus, whereby the time taken for the passage of 2 litres of air through the specimen was noted, and also the pressure attained, Mr. Tyrie said the orifice plates in the tube connecting the upper and lower tanks required to be altered to suit the type of sand under investigation. Experience had shown that the product of time and pressure was for all practical purposes a constant, and, accordingly, the apparatus might be used for control purposes, by disregarding the time factor and merely noting the pressure attained. This did not mean, however, that pressure only might be measured, as stated in the synopsis of the Paper; he suggested that that statement was distinctly misleading and ought to have been omitted. Further, in indicating the use of this apparatus by pressure method alone, stress ought to have been laid upon the importance of determining a time-pressure constant for each particular orifice, since there would be a different constant according to the size of orifice used. If, then, the time factor were to be disregarded and a permeability figure computed from consideration of pressure alone, the orifice must be standardised and the standard must be adhered to. This was not explained in the Paper, and the omission would lead to false results and an erroneous impression of the value of the apparatus in the hands of those unfamiliar with it.

Finally, Mr. Tyrie thanked the members of the Sub-Committee for the time and labour they had expended on the subject of sand testing, and expressed the hope that their work might be brought to a satisfactory conclusion before long, with the adoption of internationally standardised methods, so eagerly awaited by all interested in the foundry industry.

Correlation Possible.

Mr. N. D. Ridsdale, commenting on Mr. Tyrie's expression of regret that the Sub-Committee was not yet in a position to recommend a definite set of apparatus for determination of permeability, or a definite size of test-piece, said that for the time being the Sub-Committee had not arrived at a definite conclusion, but intended to do so as soon as possible after hearing the views expressed at this conference. The Report afforded an opportunity for the expression of such views. No one, of course, wished to recommend an apparatus which might become valueless within two or three months as the result of the recommendation of a better one. However, that state of affairs need not arise, because, in correlating tests, the Sub-Committee had discovered, as stated in the Paper, that the B.C.I.R.A. had modified its permeability apparatus in such a way that it was possible to test A.F.A. test-pieces with it, and the A.F.A. apparatus was equally able to measure permeability by the use of the B.C.I.R.A. test-pieces. So that, whichever permeability apparatus one purchased, it could be used for making tests on either test-pieces.

Recommendations Needed.

Mr. C. H. Kain (President, London Branch), after thanking the Sub-Committee for having collected and published the information contained in the Paper, asked whether, inasmuch as no recommendation was made, it was within the powers of the Sub-Committee or the Institute to publish the work that had been done so far, or to make that work available at least to the members of the Institute, so that they could form their own conclusions as to which apparatus was best for their purposes. If the results of the Sub-Committee's investigations and a *précis* of its discussions were made available, the members would be assisted thereby in making their choice.

In reply to a question by the chairman, Mr. Kain said he had in mind some amplification of the information given in the Paper. For example, it was stated in the synopsis of the Paper that the Committee had investigated routine methods of testing green sands; if more detail were given to that work, those who were anxious to make rapid headway in regard to sand testing could decide for themselves which was the best apparatus to adopt. The Paper had been awaited for a considerable time; he personally had been waiting for it for six months with a view to modifying his own sand practice, and though he sympathised with the Committee in its inability to make definite recommendations at this stage, he confessed that he was disappointed in not having definite recommendations to work on straight away. However, if more information were available, he could probably decide upon an apparatus which would suit his own requirements.

The President felt that that would be an expensive way of proceeding. He suggested that members peculiarly interested and who had problems might state those problems to the Committee and ask for answers individually.

Mr. N. D. Ridsdale agreed that that might be a way out. He pointed out, however, that the reason why the Committee had not made a definite recommendation was that, although some experiments had been made, the results of which, no doubt, would constitute a useful guide to those concerned, one or two final experiments remained to be done in order to settle the question with regard to test-pieces; there was not a great deal remaining to be done, so that it ought to be possible to arrive at conclusions before long. He imagined that within a few months, at any rate, the Committee would be able to give Mr. Kain the information he wanted, and he considered it would be wise to wait a little longer, until the Committee had obtained the remaining information which was still necessary in order to see exactly where the experiments had led to.

Mr. J. W. Gardom (Convener, Technical Committee), after thanking the members of the Sub-Committee for their work, said that he personally had bought a sand-testing apparatus, and he was glad to hear that figures were available to show that there was agreement between the results obtained with one apparatus and with another, so that his results were comparable with those obtained by other people. Those figures had not been published, but he suggested that it would be a good thing to publish them; he agreed with Mr. Kain that if the Committee's information were made available the members would derive much help in arriving at a decision as to the apparatus they should use.

An Example of Correlated Figures.

Mr. N. D. Ridsdale said that the Committee had a great many test results which could be published, but his general experience was that if one published a mass of figures and left people to wade through them, often they would not wade; unless the published matter was moderately cut and dried, it did not serve the purpose of publication, and, of course, the cost of publishing a mass of figures was considerable.

Figures showing the comparison between permeability tests in A.F.A., Richardson's and the modified B.C.I.R.A. apparatus were given in Table II of the Paper. With all these three apparati one could get time and pressure readings which could be converted into A.F.A. permeability numbers; one could express permeability in the way the A.F.A. was accustomed to express it, and could get an immediate relationship, on a given test-piece, with any of the three instruments; any of the three instruments would give the same permeability figure for all practical purposes when converted into A.F.A. terms. Further, it did not matter which size of nozzle was used in Richardson's apparatus; the relationship was direct and immediate.

Mr. A. Tipper asked if Mr. Ridsdale could give an example of that relationship from the figures in Table II.

Mr. Ridsdale replied that he could. Mr. T. R. Walker, with his standard A.F.A. apparatus, obtained a permeability figure of 51.9 for the particular sand referred to. The permeability figure, as determined in Richardson's apparatus by Mr. Walker, using a $\frac{1}{4}$-in. nozzle, was 50.5, and when using a $\frac{3}{16}$-in. nozzle the permeability figure was 50.7. So that for all practical purposes there was satisfactory agreement. The figures given to represent the results obtained in the B.C.I.R.A. apparatus—which was the old type of apparatus—showed merely the time, in seconds, for the explosion at a certain gas pressure. The relationship between the results obtained in the A.F.A. and Richardson's apparatus, on the one hand, and the earlier

type of B.C.I.R.A. apparatus (using coal gas) on the other hand, was not immediately apparent; but if the sand were tested in the later modified B.C.I.R.A. apparatus the result could be converted into a permeability figure of something like 51.

Mr. Tipper said that one would expect this relationship to hold good between results obtained on the A.F.A. apparatus and on the Richardson apparatus as shown in Table II, since the Richardson test represents only a modification of the A.F.A. test, but the results of tests on B.C.I.R.A. apparatus in this Table do not show direct relationship to the other tests. It would be helpful to publish figures on the new modified B.C.I.R.A. apparatus under similar conditions.

Mr. Ridsdale agreed that there had not been found a means of converting readily into comparable permeability figures the results of tests on the earlier form of B.C.I.R.A. apparatus, in which gas was used. But the results of tests on the new form of B.C.I.R.A. could be converted, because in that apparatus there was a tank and a definite volume of air was forced through the specimen, as in the A.F.A. apparatus.

Influence of Aeration.

Mr. John Hird said he had not seen any statement as to the sieve mesh through which the sand was passed before testing. This was important, because if the sand were passed through $\frac{1}{16}$-in. mesh the permeability figure would be much higher than it would be if the sand were passed through $\frac{1}{8}$-in. mesh.

Mr. Ridsdale said he gathered that Mr. Hird was referring to the aeration.

Mr. Hird said that he was.

Mr. Ridsdale replied that the Committee had not standardised any definite mesh through which the sand should be passed before test, but he had no doubt that that would be desirable in order to obtain a satisfactory relationship.

Mr. Hird added that it was very desirable, because by sieving the sand through $\frac{1}{16}$-in. mesh before testing one could push up the permeability figure, on the A.F.A. test, by 20 points; a sand which otherwise would give a figure of, say, 20, would give a figure of nearly 40 if passed through $\frac{1}{8}$-in. mesh.

Mr. Ridsdale said it was understood, of course, that the sand should be sieved before testing, because if it came straight from the mill it would usually be kneaded together in lumps.

Mr. Hird replied that he had in mind sand from the mill aerator. It was not in lumps, of course.

When and Where to Sample.

Mr. J. H. Cooper said it was a good thing to take the sand from the aerator and ascertain whether it was sufficiently permeable or not, and if necessary the permeability could be increased by adding a little coarser sand to the original sand or by taking the silt from the original sand. He added that by passing the sand through a sieve one might so reduce the moisture content that an entirely different reading might be obtained.

Mr. Ridsdale agreed that in the ordinary way it was best to take the sand direct from the aerator, because the sand was thus tested in the condition in which it had to be used in practice.

Mr. G. L. Bailey, M.Sc., said he hoped the Committee were taking the question of grain size of the sand into consideration, particularly as regards its effect on permeability. An interesting Paper was being read at the current meeting of the American Foundrymen's Association on this question, which would well repay the Committee's consideration. (H. W. Dietert and F. Valtier, "Grain Structure Control Insures Mold Permeability Control.") These authors emphasised the difficulty of increasing the permeability of a fine grain sand by small additions of coarser material.

Influence of Sieving.

Mr. C. H. Kain asked if the Committee had considered the problem of sieving sand, standardising a mesh and standardising a method of using sieves, because he had found that if a particular sample of sand were sieved for five minutes, or 50 or 100 strokes, one obtained certain results, but if sieving were continued indefinitely the results would vary continually throughout the day purely as the result of wear. Was the Committee prepared to recommend a standard method for securing uniform control, or alternatively, did the Committee consider that the sieving of foundry sands was not worth while?

Mr. Ridsdale replied that the Committee had not dealt with that aspect of the subject.

Mr. Kain, commenting on Mr. Cooper's reference to the addition of coarser sand to the original sand with a view to increasing permeability, said he did not see that the permeability would necessarily be increased thereby. He did not dispute that grain size had a considerable effect upon permeability, but he asked if the Committee considered that a routine test or any test for ascertaining grain size was worth while, from the point of view of the quality of the castings produced and not merely from the point of view of the permeability of the sand—for, after all, the foundryman's object was to produce castings.

Mr. Cooper said that by the addition of a little coarser sand to a fine sand he had certainly improved permeability; he had clear proof of that.

Reading Richardson's Apparatus.

Mr. Ridsdale, replying to Mr. Tyrie's criticism of the Committee's statement to the effect that pressures only could be measured by Richardson's apparatus, said the statement in the synopsis was rather ambiguous, and the Committee did not mean that it was possible to read pressures only. The Committee meant to convey the meaning that one might, or one need, read only pressures, having once got the time factor; one could take the time factor as a constant and read only the pressures, so obtaining a good guide as to permeability. He agreed also that the point with regard to orifices might be made a little more clear; if one changed the orifice, of course, the time factor was changed.

Compression and "Lifting" Properties.

Mr. J. Hird mentioned an experience with A.F.A. test-pieces, which experience he believed applied to any size of test-piece. It was that a sand giving a higher compression reading was not necessarily a better lifting sand—and, after all, that was what one was testing for. The strength did not matter, so long as one obtained a sand with a good lift and one which would withstand the wash of the metal. Sometimes a sand giving a high reading on the machine had a worse lift than one giving a lower reading.

Mr. A. Tipper asked if Mr. Hird could suggest a test which would indicate better the lifting property of the sand.

Mr. Hird replied that he could not, though he had been trying to do so, and would like to be able to introduce something satisfactory. He had proved that the tensile-test graph followed the same lines as that of the compression test, so that the solution was not in tensile testing.

Mr. Kain asked whether tests concerning the lift of the sand were taken in conjunction with permeability tests. Very strong sand, he said, might be impermeable, and therefore, when an attempt was made to lift the mould from the pattern at atmospheric pressure, one would push off the sand; if the sand were more permeable, however, the air would pass through it and prevent the formation of a slight vacuum under the cod, and possibly assist the lift.

Mr. Hird said the tests were made in conjunction with permeability tests, and the difference was negligible.

Mr. J. H. Cooper asked if Mr. Hird had made tests with different sands on the same pattern plate.

A Useful Hint.

Mr. Hird replied that he had, for he was anxious that the tests should be comparable.

Mr. Cooper said that the use of paraffin alone on pattern plates had a detrimental effect, for it resulted in stickiness, but by the addition of approximately 1 oz. of Colza oil (sweet oil) to 1 quart paraffin one obtained a wash that was perfect for pattern plates.

Mr. J. G. Pearce (Director, B.C.I.R.A.), commenting on Mr. Tyrie's remarks concerning the dummy pointer on the B.C.I.R.A. bond or compression-testing apparatus, said it was originally fitted as standard, but it was found to require $\frac{1}{2}$ lb. pressure to keep it in position; it was abandoned because it was found that, generally speaking, there was ample time to take the reading before fracture occurred, so that a fixed pointer was not necessary. The Association, however, was considering the problem with a view to fixing as standard a dummy pointer which required practically no increase in pressure to keep it in position.

On the motion of Mr. J. H. Cooper, a vote of thanks was accorded Mr. Ridsdale and the Committee for the Paper.

Dr. H. Ries, U.S.A., wrote that for routine work it was possible to use a pressure reading A.F.A. apparatus, the same as with the Richardson, providing, of course, the readings apply to the sand in daily use. He thought one advantage of the A.F.A. permeability apparatus over Richardson's was that it had no upper tank which needed to be refilled with water. Personally, he did not like the mercury seal, for if the apparatus be carried around the mercury might be spilled. He had no objection to the use of the spring-compression machine provided the spring did not lose its temper. Some years ago he tried double-end ramming on the 2-in. piece, but came to the conclusion that the advantage gained was not sufficiently clear to warrant it. The method of placing one core on another for testing is ingenious.

New Mechanised Plant at the Holwell Works of The Stanton Ironworks Company, Limited

(*Concluded from page* 135.)

Conclusion.

The Holwell plant is of outstanding interest as it represents a purely British endeavour—mainly a co-operation between the Stanton engineers and August's, Limited, of Halifax. That it has been successful is shown by the two facts: that it has considerably lowered the costs of production and that it has enhanced quality. There is still a third factor of equal importance, and that is its elasticity. This is shown by the fact that at the time of our inspection plans were being hurried forward for the changing over of the type of production from pipe specials to cast-iron road plates, to be used in connection with the paving of the Mersey Tunnel. We can well imagine that many foundries would assume these castings to be an exceedingly easy proposition. The reverse, however, is the truth, as experience has shown that to ensure long life a special specification has to be evolved. The meeting of this is of peculiar interest, and we are pleased to announce that this will form the subject of an article in the near future from Mr. P. H. Wilson, to whom we would express our sincere thanks for the facilities he has afforded us for the preparation of this Paper.

XUM

This Week's News in Brief.

Trade Talk.

MESSRS. BRADLEY & FOSTER, LIMITED, are reported to be starting up a new plant, at Blenavon, in South Wales.

MR. ULYSSE SOTIRAKI of the Fonderie Le Pirée, Athens, is proposing to re-equip his foundry. His postal address is "Ikoniou 6, Athens, Greece."

IT IS REPORTED that Japan has purchased 16,000 tons of hematite ore from the Broken Hill Proprietary Company's stocks at Port Kembla.

WORK HAS BEEN STARTED on excavations on the site for buildings to house new rolling plant at the Redbourne Hill Works, Scunthorpe, of Messrs. Richard Thomas & Company, Limited.

MESSRS. RUSTON & HORNSBY, LIMITED, Lincoln, have received from Messrs. Workman Clark (1928), Limited, of Belfast, an order for four 100-kw. auxiliary generating sets for a vessel being built by them for Andrew Weir & Company.

AN EXTENSIVE TRADE in scrap iron is being developed in New Zealand with Japan, and a further 7,200 tons of metal were despatched last month. Between January and April Japan purchased 14,175 tons of scrap iron from New Zealand.

A NEW BRANCH OF TRADE is to be opened at Bo'ness harbour and dock. Arrangements have been made for the importation of steel billets from Lincolnshire, which will be despatched by rail from Bo'ness to West of Scotland steelworks.

ONE OF THE LARGEST Soviet ships seen in the Clyde is now being loaded at Princes Dock. She is the "Kim," a 7,000-ton steamer, and is taking a cargo of building material and machinery, amounting to 700 tons, from Glasgow to Leningrad.

MESSRS. DORMAN, LONG & COMPANY, LIMITED, have decided to restart a blast furnace at their Cleveland Works, Middlesbrough, to produce basic iron. This will increase the number of blast furnaces in operation on the North-East Coast to 19.

THE NEW STEAMER "Arakaka," built for Messrs. Booker Bros., Connell & Company, Limited, Liverpool, by Messrs. Lithgows, Limited, Port Glasgow, has completed very successful trials on the Firth of Clyde. She has a deadweight capacity of 4,100 tons and is 334 ft. long, and will trade between Britain and Demarara.

MESSRS. SIR WILLIAM ARROL & COMPANY, LIMITED, have secured a contract for an extension scheme at the factory of Scottish Dyes, Limited, factory at Grangemouth. The scheme includes a four-storey building with an adjoining warehouse of brick and steel. About 500 tons of steel will be used in the construction.

THE CLYDESDALE STEEL WORKS, Mossend, belonging to Messrs. Stewarts and Lloyds, Limited, are likely to experience a busy period for some months. There are now five melting furnaces in operation, the largest number for a very long time, and a night shift has started. This week 300 employees were given their first shift for a long time, and the works will be fully employed for at least four months.

A DISPUTE BETWEEN the employees of Albion Motors, Limited, of Scotstoun, Glasgow, and the company has resulted in a number of men stopping work. The dispute arose through the introduction of a new rate for piecework. The men concerned are members of the National Union of Sheet-Metal Workers and Braziers.

IT IS REPORTED from Milan that Italian producers of rolled steel have formed a voluntary cartel for a period of five years in regard to output, sales and prices. The new cartel succeeds the compulsory association which expired last February. During the period of its operation rationalisation of the producing concerns is expected, while members will be allowed to work without fear of competition from newcomers.

A FURTHER EXTENSION and improvement scheme at a Falkirk foundry was announced at the Dean of Guild Court, Falkirk, this week, when the Grahamston Iron Company, Limited, placed two petitions before the Court. The first was for the erection of a new moulding shop, and the second for an extension of the existing enamelling shop. In announcing the decision of the Court to grant the petitions, Dean of Guild Wallace said it was gratifying to see the faith Mr. Walter Mitchell and his firm had in the future. Five weeks ago the Grahamston Iron Company received permission to make a large extension.

THE IRONWORKS of Messrs. William Dixon, Limited, Glasgow, known as "Dixon's Blazes," at Govan, is shortly to resume operations, after having been idle for over two years owing to the poor demand for pig-iron. Over 300 men will be taken on, and the company are to put into blast one of their large modern-type coke-fed blast furnaces with a capacity of 200 tons per day. It is intended as soon as trade warrants it to follow with the blowing-in of another furnace of larger capacity. The production of these two furnaces will be 3,000 tons per week. The works have been kept well in line with the modern trend of blast-furnace practice with a view of meeting foreign competition.

A BRIGHTER OUTLOOK is presented at the Clydebridge Steel Works, Cambuslang, Glasgow, of Messrs. Colvilles, Limited, by the announcement that the works were being fully manned. During the past four years the works have been either totally idle or only one shift has been employed, but since the commencement of the year two shifts have been in operation, and the men have been at work for two weeks in succession and the third week on the unemployment register. The three-shift system is now being started, and, although it will not mean the employment of many additional men, those who have been out every third week will now have continuous employment.

MESSRS. SMITH & MCLEAN, LIMITED (controlled by David Colville & Sons, Limited), and Messrs. Frederick Braby & Company, Limited, have secured a considerable share of a contract placed by the Argentine Government with a British group. The total value of the contract is £700,000, and is for galvanised sheeting for locust fencing. The order comprises 13,500,000 sheets, and will be used to construct 11,000 miles of fencing. The entire order must be completed by December, when the locusts begin to fly. A similar order was placed ten years ago with U.S.A. interests, and satisfaction is felt in iron- and steel-trade circles in this country that the new contract has come to Britain. The weight of the sheets will total 36,000 tons.

THE CARGO AND PASSENGER STEAMER "Chandravati," built for the Bombay Steam Navigation Company by Messrs. Harland & Wolff, Limited, Glasgow, has carried out trials on the Clyde. She is about 1,200 tons gross. The "Acklam Cross," the first British electric tug, has completed trials in Aberdeen Bay. Built by Messrs. Hall, Russell & Company, Limited, Footdee, Aberdeen, for Messrs. Robinson & Crosthwaite, of Middlesbrough, the vessel has aroused considerable interest in shipping circles. She is, in addition to being the first British electric vessel to have high-speed prime movers, the first electrically-propelled vessel to be electrically started and the first electric tug to have a clear afterdeck. She is 98 ft. overall, with 22-ft. beam. Power is supplied by two high-speed Brotherhood-Ricardo Diesel engines driving electrical generators, which supply current to an electric motor which drives a single-screw propeller. The propelling machinery can be directly controlled from the navigating bridge and the wheel-house, as well as from the engine room. The design of the machinery permits of a totally clear afterdeck.

Contracts Open.

Blackpool, September 11.—Supply and erection of gas boosters, for the Corporation. The Gas Engineer.

Blackpool, September 11.—About 4,500 yds. of 30-in. dia. cast-iron or steel gas pipe, with special connections, for the Corporation. The Gas Engineer.

Rainford, September 12.—Provision and laying of 3,000 yds. of 6 in. cast iron water main. The Surveyor, Council Offices, Rainford.

Adelaide, October 17.—Supply and erection of four turbo blowers and three compressors complete with motors and starters, for the Engineering and Water Supply Department of the South Australian Government. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Reference G.Y. 12,890.)

Aden.—(1) Pressed steel-plate tank, 100,000 galls. capacity; (2) cast-iron spigot and socket pipes and specials, 9 in. and 10 in. dia.; (3) sluice valves, air valves, fire hydrants, etc.; and (4) surface boxes, for the Executive Committee of Aden Settlement. Mr. E. Henderson, water and drainage engineer, Aden Settlement, Aden.

Personal.

COLONEL D. BATES, J.P., T.D., who has been in the service of the British Insulated Cables, Limited, as works manager of their Prescot works for the past 38 years, is retiring from active business at the end of October. Colonel Bates will retain his connection with the company in a consultative capacity.

MR. H. A. LEWTHWAITE, who joined the staff of the Skinningrove Iron Company, Limited, in March last, has been appointed secretary of the firm. He was formerly commercial manager of Messrs. Sir W. G. Armstrong, Whitworth & Company (Engineers), Limited, Newcastle-upon-Tyne.

MR. W. J. HOOKER, who is well-known to most foundrymen in the London area, has recently joined the board of H. G. Sommerfield, Limited, of Charterhouse Chambers, Charterhouse Square, London, E.C.1. In his new capacity, he will promote the sales of all foundry requisites in and around London.

A REPRESENTATION OF PATTERNMAKERS met Mr. John Stewart at his residence last week, and presented him with a divan chair on the occasion of his retirement after nearly 40 years' service with Glenfield & Kennedy, Kilmarnock. Mr. John Willock, in making the presentation, referred to the high esteem in which the recipient was held by his fellow-workers, and wished him many happy days in his retirement.

MR. D. M. M'LACHLAN has been appointed manager of the ship-repairing works of Messrs. William Beardmore & Company, Limited, at Liverpool. Mr. M'Lachlan received part of his early training with Messrs. Beardmore, and after spending some time in Belfast, returned to the firm's Dalmuir Yard, where he became assistant shipyard manager, and subsequently shipyard manager. In 1920 he accepted the position of shipyard manager to the Shanghai Dock & Engineering Company, Limited, in Shanghai, but in 1923 returned to Britain and became shipyard manager to Messrs. Vickers Armstrong, Limited, at Barrow-in-Furness.

Obituary.

SIR MALCOLM ROBINSON, who was Chief Inspector of Factories from 1917 to 1920, died on Sunday, August 27, at Parkstone, Dorset, at the age of 76.

MR. J. B. SHEARER, of Denny, a patternmaker, for many years on the staff of Messrs. J. G. Stein & Company, Limited, Castlecary, died last week after a short illness, at the age of 28.

MR. ALEXANDER CALDWELL, test-house manager at Clydesdale Steel Works, Mossend, died very suddenly on August 28. Mr. Caldwell, who was 59 years of age, was taking part in a foursome at golf when he collapsed and expired immediately.

MR. JAMES FORSYTH, one of the best-known figures connected with Denny foundry industry, died at his home in Glasgow Road, Denny, on August 26. Mr. Forsyth, who was 69 years of age, was born in Dunnipace. He commenced work in a Bonnybridge foundry immediately upon leaving school, but after a few years entered the employ of Messrs. Cruikshank & Company, Limited, Denny Iron Works, where he remained until the time of his death, a period of 54 years, during the last 30 of which he was leading foreman in the light-moulding department. Mr. Forsyth had the wonderful record of never being off duty owing to illness during the 54 years of service with the firm, excepting on an occasion when he had his feet burned in an accident.

New Companies.

Anglo-French Wire Dies, Limited, 11, Halliwell Street, Manchester.—Capital £100 in £1 shares. Directors: P. Ferret and J. W. Vernon.

Arthur Lowcock, Limited, 36, John Street, Bedford Row, London, W.C.1.—Capital £13,090 in £1 shares. Fuel economiser manufacturers. Directors: D. C. L. Green, F. D. L. Green and A. Smallwood.

Company Incorporated Outside Great Britain.

Aktiengesellschaft der Eisen-und Stahlwerke Vormals Georg Fischer (George Fischer Steel and Iron Works), Britannia Works, Kempston Road, Bedford.—Incorporated in Switzerland in April, 1930. Formed to carry on the business of iron and steel founders, etc. Capital 25,000,000 fcs. Persons authorised to accept service: P. Buiher, Britannia Works, Kempston Road, Bedford; C. Zehuder.

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WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.

JAMES & RONALD RITCHIE, LTD.,

Telephone : 3852 (2 Lines). MIDDLESBROUGH. Telegrams : "Ritchie, Middlesbrough."

Raw Material Markets.

No fresh feature of particular interest has developed in the iron and steel markets during the past week. Developments are on steady lines. The markets maintain a good tone and a further expansion in the volume of trade is looked for over the autumn and winter months.

Pig-Iron.

MIDDLESBROUGH.—Home consumption of Cleveland iron continues to show steady, though slow, expansion. Buying has been on a fair scale, and there are hopes of further improvement in the last quarter of the year. Some forward purchasing has been seen. Some fair export sales have also been made, in face of the difficulties which still exist in doing business abroad. It is estimated that production now about balances current demand, and more furnaces will have to be put into blast if a substantial increase in consumption is seen, as there is now very little Cleveland iron in stock. Owing to the better steel output there is an increased demand for basic iron, and Messrs. Dorman, Long & Company, Limited, have this week restarted a furnace on this grade of iron. To obtain business abroad makers have to quote low prices, but quotations to home consumers remain stabilised at the levels which were fixed several months ago. No. 3 Cleveland G.M.B. is quoted at 62s. 6d. per ton delivered Middlesbrough area, 64s. 6d. delivered North-East Coast, 62s. 3d. delivered Falkirk and 65s. 3d. delivered Glasgow. No. 1 foundry iron is at a premium of 2s. 6d. per ton, and No. 4 foundry and No. 4 forge at a discount of 1s. per ton.

Stocks of East Coast hematite are declining slowly, and the position of the makers continues to improve. Steelmakers continue to take good quantities of hematite, and further heavy deliveries have been made to South Wales. No change in prices has been made, but an agreement among the makers resulting in a higher level of quotations is expected before long, and there has been some speculative buying in anticipation of this move. Meanwhile 59s. is asked for mixed numbers and 59s. 6d. for No. 1 quality, with slightly lower figures, according to circumstances, for export.

LANCASHIRE.—September has brought an end to suspensions of deliveries owing to annual holidays in various centres, and conditions generally are more normal. The foundries making light castings are relatively the most actively engaged and are taking fair quantities of iron. The position as regards deliveries to other consuming trades continues to leave room for substantial improvement. A few engineering concerns are taking good quantities of iron, but, except in odd instances, there has been no material change for the better in the position of textile machinists. There are still good quantities of scrap iron available, but the price position in this respect is a little firmer than it was. Pig-iron prices are unchanged, Staffordshire and Derbyshire No. 3 being quoted for delivery to users in the Manchester price zone on the basis of 67s. per ton, with North-East Coast iron at about the same figure, Northamptonshire at 65s. 6d., Scottish foundry at around 80s., East Coast hematite at about 74s., and West Coast hematite at from 80s. to 81s. per ton.

MIDLANDS.—In this area there is not much new business about at the moment, but buying is expected to become more active as the month progresses. Subject to a small rebate to large consumers, prices are unchanged at 62s. 6d. for Northants No. 3, and 66s. for Derbyshire, Lincolnshire and North Staffs No. 3, including delivery to Birmingham and South Staffordshire stations. Hematite, though in slightly better demand, is still somewhat slow. East Coast and Welsh irons, which have free markets, are quoted at from 74s. 6d. to 77s. 6d. per ton delivered. West Coast foundry hematite, which is controlled, is priced at 84s. 6d. Some Scottish No. 3 iron comes into this area for special purposes, the price being around 85s. From other sources medium-phosphorus iron is obtainable at from 70s. to 75s. per ton, according to analysis. Refined low-phosphorus pig-iron can be obtained at from 80s. to 90s. per ton.

SCOTLAND.—There are four furnaces in Scotland making foundry iron, and their output is quite sufficient to take care of the demand, which is still slow. Cleveland iron, owing to the better activity among the Falkirk foundries, is in better demand, but this improvement has not yet spread to Scottish iron, which is still quoted at the official minimum of 65s. f.o.t. furnaces for No. 3 and 67s. 6d. for No. 1, compared to 62s. 3d. at Falkirk and 65s. 3d. at Glasgow for Middlesbrough No. 3. Other English irons are quoted at 1s. 3d. per ton below those for Middlesbrough iron. Quotations for steel-making iron are :—Mixed numbers Scottish hematite, 66s.; ordinary mixed numbers West Coast hematite, 68s. 6d.; Scottish, Lincolnshire and Indian basic, 57s. 6d., all delivered Scottish steelworks.

Coke.

The foundry coke market shows little or no change. The foundries have not yet started to cover their autumn and winter requirements, and demand at the moment is slow. There is talk of attempts to put prices on a basis more satisfactory to the makers, but so far there are no developments to record. For delivery in Birmingham and district the present price for best Durham coke is 36s. to 38s., with the cheaper grades at 34s. to 35s., good Scottish coke 39s. to 40s. and Welsh coke, according to analysis, from 38s. to 45s. per ton.

Steel.

Business is becoming more settled as the autumn approaches, and a considerable volume of inquiry has developed, says the official report of the London Iron and Steel Exchange. Although export business remains quiet, overseas buyers appear to be taking greater interest in the market, and in some directions trade is expanding. Business in semi-finished steel has revived again after a short period of quietness. The position of the British works producing this class of material is satisfactory and Continental competition which threatened recently has been checked by the fall in the exchange. This also affected the competition experienced by the makers of finished steel in the home market, and the Continental quotations in most districts in this country, when the duty is included, are higher than the British prices. Export business in finished steel is irregular, but the outlook is promising, as it is reported that a number of markets are short of stocks.

Scrap.

A firm tone continues to distinguish the scrap market, although this is less pronounced in connection with old iron than with steel scrap. In the Middlesbrough area buyers of cast-iron scrap are not inclined to do more than cover present needs, although sellers hint at the likelihood of an advance on the present quotations of 39s. for ordinary quality and 41s. for machinery metal. In South Wales heavy cast iron in large pieces and furnace sizes is displaying more activity and tends to become firmer at 45s. to 46s. Light cast scrap has an improved demand at 40s. to 42s. 6d., but good cast-iron machinery scrap in foundry sizes remains slow at 45s. to 47s. 6d., as the local foundries' requirements are easily satisfied. In the Midlands the demand for cast-iron scrap is very consistent, and prices are firm. For selected heavy machinery scrap in handy sizes 47s. 6d. delivered is being paid, 45s. for good heavy metal, and 38s. 6d. to 40s. for clean light cast iron, all delivered works. In Scotland cast-iron scrap is moving slowly, and machinery quality in pieces not exceeding 1 cwt. is 50s. per ton, with ordinary cast iron to the same specification 47s. Light cast iron is 37s. 6d. to 40s., delivered works.

Metals.

Copper.—Rather quieter conditions have ruled in the copper market. The higher prices recently seen induced a certain amount of selling and liquidation, buyers at the same time inclining to withdraw. Business with consumers is reported to have shown slight improvement, but inquiry in this direction has not so far developed as to warrant sustained or important advance in price, state Messrs. Rudolf Wolff & Company. The undertone, however, remains firm, the price is not unduly high, and the future offers a fair prospect of favourable development, with some expansion in trade demand following the quietness which prevailed over the last month.

The week's prices have been as follow :—

Cash.—Thursday, £36 1s. 3d. to £36 3s. 9d.; Friday, £36 to £36 2s. 6d.; Monday, £35 17s. 6d. to £36; Tuesday, £36 5s. to £36 6s. 3d.; Wednesday, £35 15s. to £35 16s. 3d.

Three Months. — Thursday, £36 6s. 3d. to £36 8s. 9d.; Friday, £36 5s. to £36 6s. 3d.; Monday, £36 2s. 6d. to £36 3s. 9d.; Tuesday, £36 8s. 9d. to £36 11s. 3d.; Wednesday, £35 18s. 9d. to £36.

Tin.—This metal, though at times displaying some irregularity, has been firmer. The publication of the monthly statistics disclosed the very large decrease in the total visible supply (including the carry-over in the Straits) of 5,458 tons. A rather more active business with consumers has taken place in this country and on the Continent, and more inquiry has also been reported from the United States of America. The substantial decrease in the visible supply, state Messrs. Rudolf Wolff, is to a great extent due to the heavy deliveries in America, which amounted to 8,020 tons, and may be taken as indicating the improvement which has taken place in the consuming industries in that country and which up to the present gives no indication of falling off; on the contrary, consumption both in America and elsewhere is reported to be good, and when the outlook in America clears and industrial conditions generally improve as the autumn approaches, the position of this metal should continue to develop favourably, and prices, though admittedly high, should show some further advance.

Daily quotations :—

Cash.—Thursday, £220 2s. 6d. to £220 5s.; Friday, £220 7s. 6d. to £220 10s.; Monday, £219 to £219 2s. 6d.; Tuesday, £219 5s. to £219 7s. 6d.; Wednesday, £217 7s. 6d. to £217 10s.

Three Months.—Thursday, £220 to £220 2s. 6d.; Friday, £220 7s. 6d. to £220 10s.; Monday, £219 to £219 2s. 6d.; Tuesday, £219 2s. 6d. to £219 5s.; Wednesday, £217 10s. to £217 12s. 6d.

Spelter.—This market, no doubt influenced by the Argentine order for galvanised sheets, and consequent covering operations on the part of the manufacturers interested, has displayed a hardening tendency. Messrs. Henry Gardner & Company, Limited, report that quite a fair tonnage of metal has changed over to the galvanisers. There has been slightly more interest displayed in high-grade metal, the Continent participating, but demand generally for this quality of spelter leaves very much to be desired.

Price fluctuations :—

Ordinary. — Thursday, £17 8s. 9d.; Friday, £17 1s. 3d.; Monday, £16 18s. 9d.; Tuesday, £17 5s.; Wednesday, £16 18s. 9d.

Lead.—Prices of lead have declined a little, but the position does not show much actual change. The principal consuming industries connected with the building trade continue to be well occupied, and Messrs. Brandeis, Goldschmidt & Company state that reports from the Continent indicate quite good sales there. With the approach of the end of the holiday season a falling off in the demand is not expected, and prices may improve further.

Daily market prices :—

Soft Foreign (Prompt).—Thursday, £12 11s. 3d.; Friday, £12 5s.; Monday, £12; Tuesday, £12 5s.; Wednesday, £12 2s. 6d.

Cleaning of Corroded Test Samples.—In the "Analytical Edition" of "Industrial and Engineering Chemistry," T. J. Finnegan and R. C. Corey report on comparative experiments using various methods for cleaning the corroded or tarnished surfaces of test samples, viz., mixtures of sulphuric acid and pickling agents, ammonium citrate, and a mixture of caustic soda and zinc, thus determining the loss by corrosion. The accuracy of the various methods is discussed.

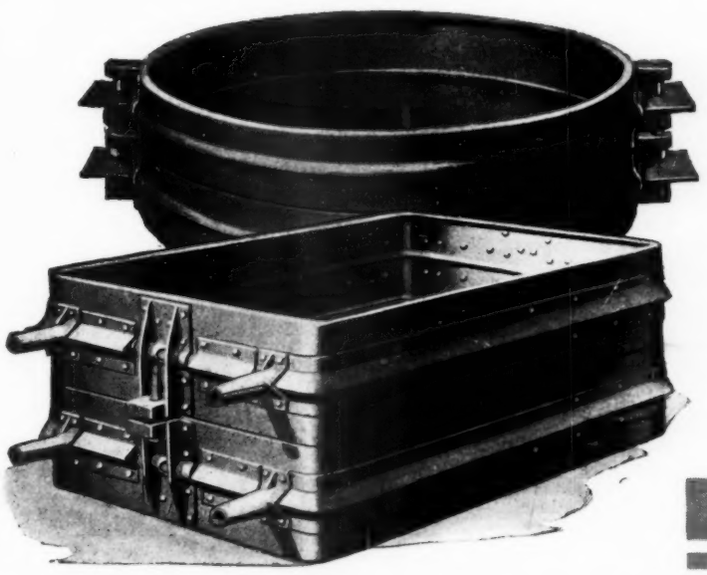
Revised British Standard Graphical Symbols.—The British Standards Institution has issued British Standard Graphical Symbols for General Electrical Purposes (B.S. No. 108—1933). The revision of the previous edition has been thorough, and although no changes have been made merely for the sake of a change, the internationally-agreed symbols have been substituted in a large number of cases. In other cases the international symbols are in conformity with current British practice, so that no change has been necessary. The new list of symbols is fuller than the old list. Copies of this new list may be obtained from the British Standards Institution, Publications Department, 28, Victoria Street, London, S.W.1. (Price 2s. 2d. post free.)

Service Sterling

SOLID RIBBED ROLLED STEEL
MOULDING BOXES

One of the first steps you should take towards maximum efficiency in your foundry is to install Sterling Moulding Boxes. Those vital qualities lightness, rigidity, strength and accuracy so necessary for the rapid handling of boxes in the modern foundry are the outstanding features of the Sterling Box.

We invite you to prove this statement by allowing us to demonstrate to you how Sterling Boxes can save you money. There are some thirty standard types to meet almost every foundry need. For special purposes our technical staff will gladly design for you the most economical box for your job.



STERLING FOUNDRY SPECIALTIES LIMITED, BEDFORD

London Office:— 13, Victoria Street, S.W.1.

Agents at:— MANCHESTER. GLASGOW. NEWCASTLE-ON-TYNE.

TELEGRAMS: "STERFLASK, BEDFORD" TELEPHONE: 3345 BEDFORD.

CODE: WESTERN UNION

RAW MATERIALS—PRICE LIST.

(Wednesday, September 6, 1933.)

COPPER.

	£	s.	d.
Standard cash	35	15	0
Three months	35	18	9
Electrolytic	39	0	0
Tough	37	10	0
Best selected	38	0	0
Sheets	66	0	0
India	48	0	0
Wire bars	39	15	0
Ingot bars	39	15	0
H.C. wire rods	41	15	0
Off. av. cash, August	36	2	3 3/11
Do., 3 mths., August	36	6	6 3/4
Do., Sttlmnt., August	36	2	4 7/11
Do., Electro, August	40	12	7 4/11
Do., B.S., August	39	10	3 1/2
Do., wire bars, August	41	0	8 3/11
Solid drawn tubes			10½d.
Brazed tubes			10½d.
Wire			7d.

BRASS.

Solid drawn tubes	9½d.
Brazed tubes	11½d.
Rods, drawn	8½d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7½d.
Wire	7½d.
Rolled metal	7½d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5½d.

TIN.

	£	s.	d.
Standard cash	217	7	6
Three months	217	10	0
English	218	0	0
Bars	219	0	0
Straits	224	0	0
Australian (nom.)	—		
Eastern	223	0	0
Banca	223	10	0
Off. av. cash, August	215	5	10 1/2
Do., 3 mths., August	215	5	4 1/2
Do., Sttlmt., August	215	5	10 10/11

SPELTER.

	£	s.	d.
Ordinary	16	18	9
Remelted	16	10	0
Hard	14	5	0
Electro 99.9	19	5	0
English	17	12	6
India	16	10	0
Zinc dust	20	0	0
Zinc ashes	4	0	0
Off. aver., August	16	19	0 3/4
Aver. spot, August	16	17	4 7/11

LEAD.

	£	s.	d.
Soft foreign ppt.	12	2	6
Empire	12	10	0
English	13	10	0
Off. average, August	12	6	4 3/4
Average spot, August	12	3	7 7/11

ALUMINIUM.

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	25	15	0
Do., V.M. ex-whse.	25	5	0
Rods	30	10	0

ANTIMONY.

	£	s.	d.
English	37 10 0 to 40	0	0
Chinese, ex-whse.	26	15	0
Crude	—		

QUICKSILVER.

	£	s.	d.
Quicksilver	8 10 0 to 8	15	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	6 10 0
45/50%	12 10 0
75%	18 2 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten—	
80/85%	1/9 lb.
Tungsten metal powder—	
98/99%	2/- lb.
Ferro-chrome—	
2/4% car.	25 10 0
4/6% car.	21 17 6
6/8% car.	19 17 6
8/10% car.	18 17 6
Ferro-chrome—	
Max. 2% car.	30 0 0
Max. 1% car.	31 0 0
Max. 0.70% car.	36 2 6
70% carbon-free	10d. lb.
Nickel—99.5/100%	£225 to £230
"F" nickel shot	£202 10 0
Ferro-cobalt, 98/99%	5/6 lb.
Metallic chromium—	
96/98%	2/8 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 1/8 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel				2	5	0
Bundled steel and shrngs.	1	17	6 to 2	4	0	
Mixed iron and steel	2	0	0 to 2	1	6	
Heavy cast iron	2	5	0 to 2	6	0	
Good machinery	2	6	0 to 2	7	6	
Cleveland—						
Heavy steel				2	3	6
Steel turnings				1	11	6
Cast-iron borings				1	2	0
Heavy forge				2	10	0
W.I. piling scrap				2	0	0
Cast-iron scrap	1	19	0 to 2	1	0	
Midlands—						
Light cast-iron scrap	1	18	6 to 2	0	0	
Heavy wrought iron				2	7	0
Steel turnings, f.o.r.				1	5	6
Scotland—						
Heavy steel				2	2	6
Ordinary cast iron				2	7	0
Engineers' turnings				1	12	6
Cast-iron borings				1	13	0
Wrought-iron piling	2	2	6 to 2	3	6	
Heavy machinery				2	10	0

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	30	0	0
Brass	19	10	0
Lead (less usual draft)	11	5	0
Tea lead	8	5	0
Zinc	10	10	0
New aluminium cuttings	72	0	0
Braziery copper	27	0	0
Gunmetal	27	0	0
Hollow pewter	135	0	0
Shaped black pewter	100	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	65/-
Foundry No. 3	62/6
,, at Falkirk	62/3
,, at Glasgow	65/3
Foundry No. 4	61/6
Forge No. 4	61/6
Hematite No. 1, f.o.t.	59/6
Hematite M/Nos., f.o.t.	59/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	68/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	62/-
,, No. 3 fdry.	66/-
Northants forge	58/6
,, fdry. No. 3	62/6
,, fdry. No. 1	65/6
Derbyshire forge	62/-
,, fdry. No. 3	66/-
,, fdry. No. 1	69/-
Scotland—	
Foundry No. 1	67/6
,, No. 3	66/-
Hem. M/Nos. d/d	66/-
Sheffield (d/d district)—	
Derby forge	59/6
,, fdry. No. 3	63/6
Lincs forge.	59/6
,, fdry. No. 3	63/6
E.C. hematite	73/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	80/-
Clyde, No. 3	80/-
Monkland, No. 3	80/-
Summerlee, No. 3	80/-
Eglinton, No. 3	80/-
Gartsherrie, No. 3	80/-
Shotts, No. 3	80/-

FINISHED IRON AND STEEL.

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	9	0	0 to	9	15	0
Nut and bolt iron	6	15	0 to	7	10	0
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.	13	0	0			
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.				8	5	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ⅜ in. (Untested)	6	17	6 & up.			
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates				12	0	0
Hoops (Staffs)	9	10	0 & up.			
Black sheets, 24g. (4-t. lots)				10	0	0
Galv. cor. shts. (,,)				12	10	0
Galv. flat shts. (,,)				13	0	0
Galv. fencing wire, 8g. plain				14	0	0
Billets, soft	5	0	0 to	5	12	6
Billets, hard	6	12	6 to	7	2	6
Sheet bars	4	15	0 to	5	7	6
Tin bars				4	15	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	12½d.
Rods	11d.
Tubes	15½d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	18.34
No. 2 foundry, Valley	17.50
No. 2 foundry, Birm.	14.00
Basic	18.89
Bessemer	19.89
Malleable	19.39
Grey forge	19.39
Ferro-mang. 80%, seaboard	82.00
O.-h. rails, h'y, at mill	40.00
Billets	26.00
Sheet bars	26.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	1.86
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Steel hoops	1.75
Sheets, black, No. 24	2.25
Sheets, galv., No. 24	2.85
Wire nails	2.10
Plain wire	2.10
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.25

COKE (at ovens).

Welsh foundry	20/- to 22/6
,, furnace	15/- to 15/6
Durham and Northumberland—	
,, foundry	21/- to 25/-
,, furnace	13/6
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	16/9	to 17/3
,,	28×20 ,,	33/6	to 34/6
,,	20×10 ,,	23/10	to 24/4
,,	18¾×14 ,,	17/4½	to 17/9
C.W.	20×14 ,,	15/6	to 16/-
,,	28×20 ,,		32/3
,,	20×10 ,,		22/9
,,	18¾×14 ,,		16/6

SWEDISH CHARCOAL IRON & STEEL.

	£	s.	d.	£	s.	d.
Pig-iron	£6	0	0 to	£7	0	0
Bars-hammered, basis	£16	0	0 to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0 to	£16	0	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£30	0	0 to	£31	0	0
Faggot steel	£18	0	0 to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0 to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.	
Aug.	31 ..	36	1	3	No change
Sept.	1 ..	36	0	0	dec. 1/3
,,	4 ..	35	17	6	,, 2/6
,,	5 ..	36	5	0	inc. 7/6
,,	6 ..	35	15	0	dec. 10/-

Electrolytic Copper.

		£	s.	d.	
Aug.	31 ..	39	10	0	dec. 5/-
Sept.	1 ..	39	10	0	No change
,,	4 ..	39	5	0	dec. 5/-
,,	5 ..	39	10	0	inc. 5/-
,,	6 ..	39	0	0	dec. 10/-

Standard Tin (cash).

		£	s.	d.		
Aug.	31 ..	220	2	6	inc.	15/-
Sept.	1 ..	220	7	6	,,	5/-
,,	4 ..	219	0	0	dec.	27/6
,,	5 ..	219	5	0	inc.	5/-
,,	6 ..	217	7	6	dec.	37/6

Tin (English ingots).

		£	s.	d.		
Aug.	31 ..	220	15	0	inc.	15/-
Sept.	1 ..	221	0	0	,,	5/-
,,	4 ..	219	10	0	dec.	30/-
,,	5 ..	219	15	0	inc.	5/-
,,	6 ..	218	0	0	dec.	35/-

Spelter (ordinary).

		£	s.	d.		
Aug.	31 ..	17	8	9	dec.	1/3
Sept.	1 ..	17	1	3	,,	7/6
,,	4 ..	16	18	9	,,	2/6
,,	5 ..	17	5	0	inc.	6/3
,,	6 ..	16	18	9	dec.	6/3

Spelter (Electro, 99.9 per cent.).

		£	s.	d.		
Aug.	31 ..	19	10	0	No	change
Sept.	1 ..	19	10	0	,,	,,
,,	4 ..	19	5	0	dec.	5/-
,,	5 ..	19	10	0	inc.	5/-
,,	6 ..	19	5	0	dec.	5/-

Zinc Sheets (English).

		£	s.	d.	
Aug.	31 ..	25	15	0	No change
Sept.	1 ..	25	15	0	,, ,,
,,	4 ..	25	15	0	,, ,,
,,	5 ..	25	15	0	,, ,,
,,	6 ..	25	15	0	,, ,,

Lead (English).

		£	s.	d.	
Aug.	31 ..	13	15	0	No change
Sept.	1 ..	13	15	0	,, ,,
,,	4 ..	13	10	0	dec. 5/-
,,	5 ..	13	10	0	No change
,,	6 ..	13	10	0	,, ,,

AVERAGE MONTHLY PRICES OF RUBIO ORE (MIDDLESBROUGH).

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1895	0 12 0	0 12 0	0 11 10	0 12 0	0 12 0	0 12 3	0 12 3	0 12 4	0 12 4	0 12 6	0 12 7	0 12 6	0 12 2½
1896	0 12 6	0 12 6	0 12 9	0 12 9	0 12 9	0 12 7	0 12 9	0 12 9	0 12 9	0 13 6	0 15 0	0 14 9	0 13 1
1897	0 15 3	0 15 6	0 15 3	0 15 0	0 14 0	0 14 3	0 14 3	0 14 0	0 14 0	0 15 0	0 14 3	0 15 3	0 14 8
1898	0 15 0	0 14 4	0 14 9	0 14 6	0 15 0	0 15 0	0 14 0	0 14 0	0 14 0	0 14 9	0 15 0	0 14 9	0 14 7
1899	0 15 0	0 15 3	0 15 6	0 15 6	0 15 9	0 16 0	0 17 6	0 18 0	0 17 9	0 18 0	0 19 0	1 0 0	0 16 11½
1900	1 1 0	1 0 6	1 1 0	1 0 9	1 1 0	1 1 0	1 1 3	1 1 6	1 1 3	1 1 3	1 0 0	0 18 0	1 0 8½
1901	0 17 6	0 16 0	0 15 0	0 14 6	0 15 6	0 15 9	0 14 9	0 15 3	0 15 9	0 15 9	0 15 9	0 15 9	0 15 7½
1902	0 15 6	0 15 0	0 16 0	0 16 0	0 15 6	0 15 3	0 15 6	0 16 0	0 16 0	0 16 0	0 15 9	0 15 6	0 15 8½
1903	0 15 6	0 16 0	0 16 6	0 16 3	0 16 3	0 16 10	0 15 9	0 15 6	0 15 6	0 14 9	0 14 9	0 15 1	0 15 8
1904	0 14 9	0 15 3	0 15 1	0 15 4	0 15 3	0 15 0	0 14 5	0 14 6	0 14 6	0 14 6	0 14 6	0 14 7	0 14 9½
1905	0 15 3	0 15 6	0 15 0	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 16 6	0 18 6	0 18 9	0 18 9	0 16 2½
1906	1 0 0	1 1 6	1 0 0	1 0 0	0 19 6	1 0 0	0 19 6	0 19 4	1 0 6	1 1 6	1 1 9	1 3 6	1 0 7
1907	1 3 6	1 2 6	1 2 6	1 2 0	1 1 6	1 2 3	1 2 3	1 2 0	1 1 0	0 19 0	0 18 9	0 17 6	1 1 2½
1908	0 16 6	0 15 0	0 15 6	0 15 6	0 15 3	0 15 0	0 15 0	0 16 0	0 15 0	0 16 0	0 16 0	0 16 0	0 15 5½
1909	0 15 9	0 16 3	0 16 0	0 16 0	0 16 3	0 16 6	0 16 0	0 16 0	0 17 0	0 17 0	0 17 6	0 17 6	0 16 6
1910	1 0 4	1 0 9	1 0 9	1 0 9	1 0 9	1 0 9	1 0 9	1 0 3	1 0 3	1 0 6½	1 1 3	1 1 5	1 0 9½
1911	1 2 2½	1 2 6	1 2 6	1 1 11½	1 0 11½	0 19 6	0 19 0	0 19 0	0 19 1½	0 19 6	1 0 0½	1 1 6½	1 0 7½
1912	1 2 3	1 2 6	1 2 6	1 1 1½	1 1 6	1 1 6	1 1 6	1 2 3	1 2 6	1 3 0	1 3 0	1 2 11	1 2 2½
1913	1 2 9	1 2 2	1 1 7½	1 1 6	1 0 8½	1 0 0	1 0 0	1 0 0	0 19 10½	0 19 1½	0 19 0	0 19 0	1 0 5½
1914	0 18 7½	0 18 0	0 18 0	0 17 9	0 17 6	0 17 6	0 17 1½	0 19 7½	0 18 11½	0 17 10½	0 18 7½	1 1 0½	0 18 5½
1915	1 7 7½	1 8 6	1 9 3	1 10 2½	1 8 6	1 6 4	1 5 10½	1 6 0	1 6 10½	1 10 8½	1 13 0	1 17 10	1 9 1½
1916	1 18 6	2 0 1½	2 2 6½	2 0 6½	1 15 0	1 16 3	1 18 0	1 18 0	1 18 0	—	—	—	—
1917	} Price Fixed												
1918													
1919	—	—	—	—	2 5 7½	2 14 4½	2 16 4½	2 14 0	2 13 4½	2 13 0	2 12 7½	2 11 9	—
1920	2 17 0	3 7 9	2 15 6	3 6 7	3 0 0	2 15 0	2 14 0	2 9 9	2 7 6	2 11 0	2 12 3	2 10 0	2 15 0
1921	2 1 0	2 0 1½	1 18 3	1 17 6	1 17 6	1 17 6	1 17 6	1 5 0	1 8 9½	1 7 9	1 7 0	1 7 0	1 18 8½
1922	1 6 7½	1 5 10½	1 6 11	1 7 0	1 7 0	1 7 0	1 5 3	1 4 9½	1 4 2½	1 3 3½	1 2 6	1 2 3	1 5 2½
1923	1 2 9½	1 4 6½	1 5 2	1 4 8½	1 4 6	1 4 0	1 3 6	1 3 0	1 3 0	1 3 0	1 3 2½	1 4 9	1 3 10½
1924	1 4 2½	1 4 0	1 4 0	1 3 7½	1 3 8½	1 3 6	1 2 11	1 2 6	1 2 1½	1 1 7½	1 2 3	1 2 6	1 3 1
1925	1 2 6	1 2 1½	1 2 0	1 2 0	1 2 0	1 1 6	1 0 6	1 0 0	1 0 0	1 0 0	1 0 3	1 0 10½	1 1 1½
1926	1 1 1½	1 1 6	1 1 6	1 1 3½	1 1 3	1 1 5½	1 1 6	1 1 6	1 1 0	1 1 6	1 1 6	—	1 1 4½
1927	1 2 1½	1 2 3	1 2 1½	1 2 0	1 2 0	1 2 0	1 1 7½	1 1 0	1 1 0	1 1 0	1 1 0	1 1 0	1 1 7½
1928	1 1 0	1 1 1½	1 1 11	1 2 4½	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 3½
1929	1 2 6	1 2 6½	1 2 11½	1 3 0	1 3 0	1 3 2½	1 4 0	1 4 8½	1 4 7½	1 4 6	1 4 6	1 4 3	1 3 7½
1930	1 3 3½	1 2 6	1 1 9	1 1 6	1 0 10½	1 0 0	1 0 0	0 19 6	0 19 0	0 17 4½	0 16 4½	0 16 4½	0 19 10½
1931	0 16 1½	0 16 0	0 16 0	0 15 11½	0 15 4½	0 15 0½	0 14 10½	0 14 3½	0 14 6	0 16 8½	0 17 0½	0 16 6	0 15 9
1932	0 16 6	0 16 6	0 16 3	0 15 6	0 15 4½	0 15 0	0 14 11	0 14 8½	0 14 6	0 14 6	0 14 9	0 15 1	0 15 3½
1933	0 15 6	0 15 3	0 15 3	0 15 3	0 15 3	0 15 6	0 15 6	0 15 6	—	—	—	—	—

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